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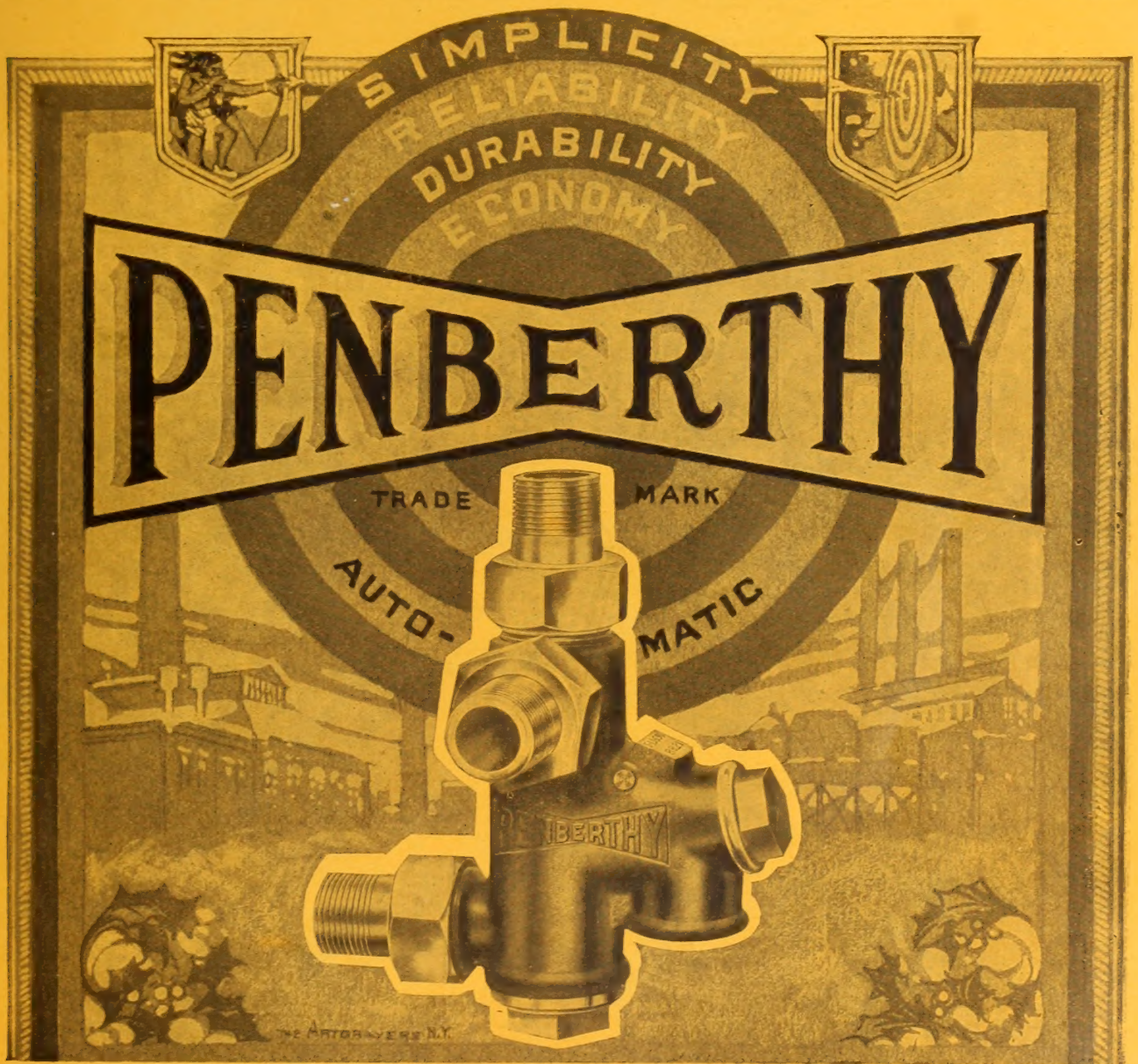
Circulates in Every Province of Canada

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 511 Union Bank Bldg

Vol. IV. Publication Office, Toronto—January 1911 No. 1



A Good New Year's Resolution

Buy the Genuine Penberthy Injector and get satisfaction ever after.
"THEY ALWAYS WORK."

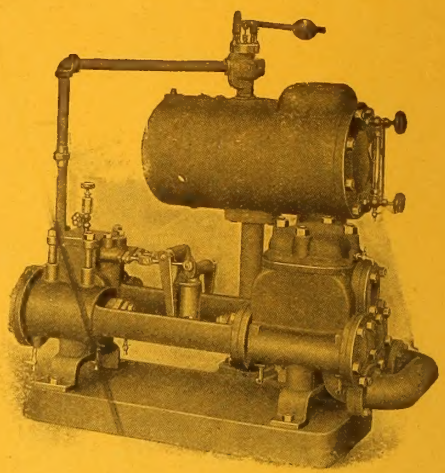
MANUFACTURED BY

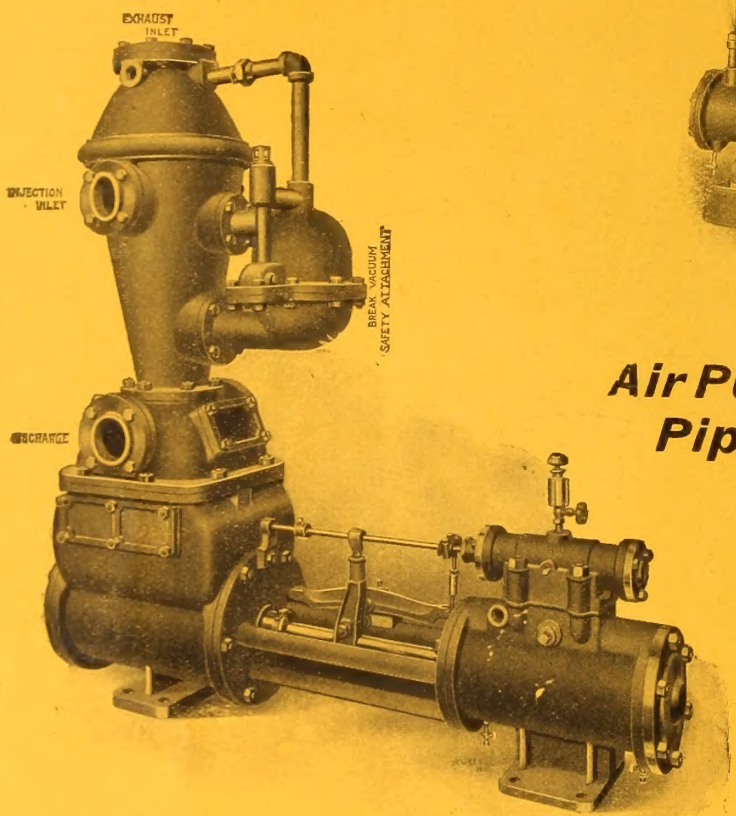
Penberthy Injector Co., Limited, Windsor, Ont.

BLAKE STEAM PUMPS
FOR
THE POWER HOUSE

Automatic Feed Pump and Receiver

A simple and effective means of draining heaters, steam jackets, etc., and of forcing water of condensation in its hottest condition direct to the boilers.





Air Pump and Spray Pipe Condenser

Will save from 20 to 30 per cent. in steam when applied to non-condensing engines or give a corresponding increase of power.

Send for Illustrated Bulletins

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The John McDougall Caledonian Iron Works Co.

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Works: 512 William Street, Montreal

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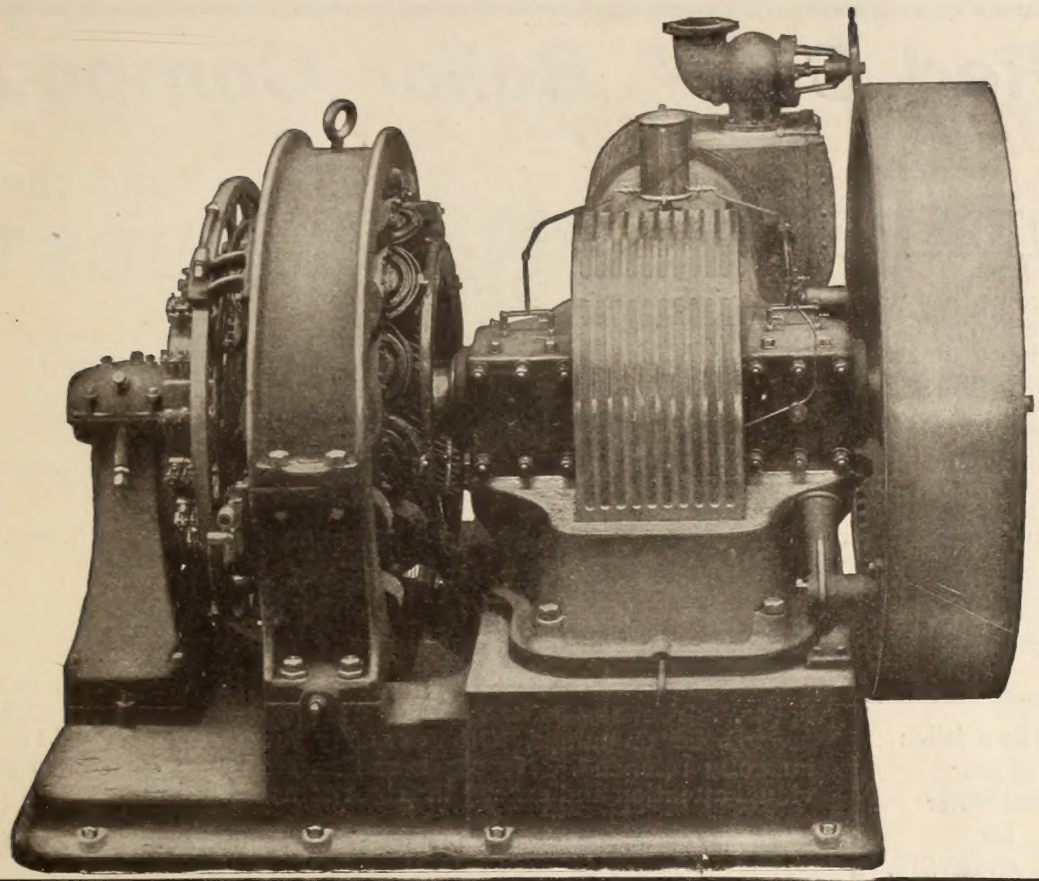

THE McEWEN

A Canadian Automatic High-speed Engine that is distinguished for its smooth-running qualities and its sensitiveness of regulation under all loads.

Built in simple and compound units of from 40 to 700 h.p. It is especially adapted for direct dynamo connection for the production of electric light and power.

All parts are few and simple and are built to template so that repairs can be quickly furnished. The bed is heavy and rigid. Cross head guides, main bearings, and face for cylinder attachment are machined in one operation. Piston type valve, double ported, frictionless. Balancing pressure plate slotted to correspond with valve seat. Produces additional passage to cylinder by providing double admission and exhaust edges. Relief valve made absolutely unnecessary. Guaranteed control by Begthrup Inertia Governor.

Tested under full load before leaving the works.

Get Our McEwen Engine Bulletin

The Waterous Engine Works Co., Ltd.

BRANTFORD, CANADA

The advertiser would like to know where you saw his advertisement—tell him.

"Red Star" Boiler Compound

is the
CHEAPEST

As a preventive and remover of boiler scale in all its forms, the superior efficiency and economy of Red Star Compound is proven up to the hilt.

and the
BEST

Many of the biggest steam boiler plants of the continent use Red Star exclusively.

Red Star is in powder form Five pounds of it, mixed with two gallons of water, make 21 pounds of liquid Compound, ready to feed to the boiler.

Buying it in powder form, you are not asked to pay freight on plain, ordinary water.

Its Price is Now Lower Than Ever

as the customs duty on several important ingredients has recently been reduced.

Send us a gallon of your Feed Water for FREE ANALYSIS.

We guarantee Red Star to prevent all new scale and to remove all old scale from any boiler to which it is applied, without the slightest damage to boiler or pumps. Otherwise any purchase money paid to us will be instantly refunded. No compound in stock---every case is given individual attention and exactly the right compound made up.

Lake Erie Boiler Compound Company
No. 11 Colborne Street - - TORONTO

Dearborn Treatment Eliminates the Most Dangerous Feature of Boiler Scale

The most **dangerous conditions** brought about by scale do not manifest themselves until it is too late—until the damage has been done.

For instance, a tube begins to leak, due to being overheated by an accumulation of scale. Overheating a tube injures it, and while it may be re-expanded and rendered tight temporarily, that tube will be the first to be renewed.

The first you know that the shell is overheated (due to scale) is by the appearance of a bag or pocket.

The first evidence that a blow-off pipe is packed with scale is that the pipe has been burned.

The first indication that a feed pipe has become filled with scale is the bursting of a pipe or fitting.

Dearborn Treatment prevents an accumulation of scale, and keeps the boilers clean all the time, eliminating danger, and saving you the cost of repairs and loss of time. Cuts you fuel bills down, too.

DEARBORN DRUG & CHEMICAL CO.

ROBERT F. CARR, President

General Offices, Laboratory and Works
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Eastern Offices, 299 Broadway
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Horizontal Tubular Boilers

Our Horizontal Tubular Boilers are carefully designed, and the materials used in their construction the best obtainable of their respective kinds.

Can We Mail You Catalog?

Write Nearest Sales Office.

We Contract for Complete Steam Power Plants, Engines included.

THE JENCKES MACHINE COMPANY, Limited

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We are manufacturers of every class of Asbestos goods, including:

"Endurol" High Pressure Sheet Packing
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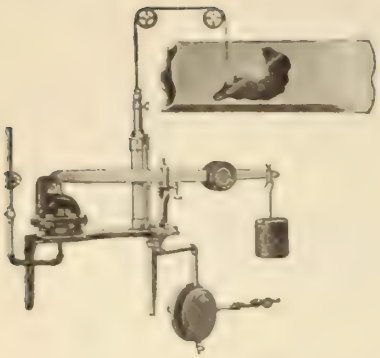
Factory: 18 St. Peter Street, MONTREAL. Offices: Coristine Bldg.

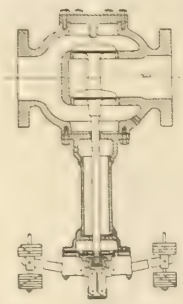


Lawrence Damper Regulator

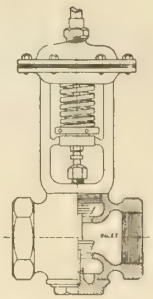
WATER REGULATORS

are sold on trial and their service is

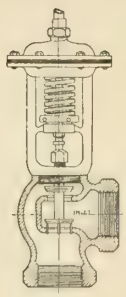
Guaranteed



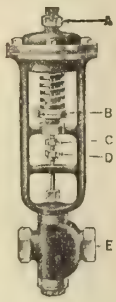
Lever Reducing Valve



Spring Reducing Valve



Pump Regulator



Fan Engine Regulator

Embodying, as they do, principles of correct design and accurate workmanship, these specialties are worth considering when in need of such. They will not fail at crucial moments, but continuously perform positive service. Get prices anyway, if only for sake of comparison.

Made by

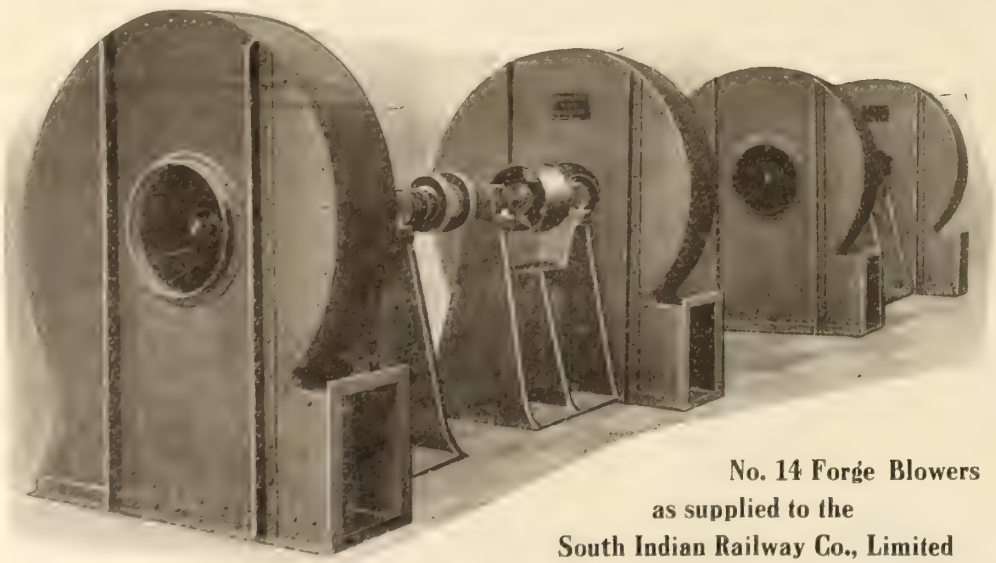
Watts Regulator Co., Lawrence, Mass.

Sold in Canada by

Power Economies, Limited, 9 St. Nicholas Street Montreal

CYCLONE PRESSURE FANS

Ask our Agents for Catalogue No. 130



No. 14 Forge Blowers
as supplied to the
South Indian Railway Co., Limited

are specially designed for supplying blast to

Smiths' Fires

and are suitable for all purposes where a small volume at a high pressure is required.

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QUALITY THE BEST

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Anglo-American Supply Co., Ltd., 311 Enderton Building

If you want to SAVE FUEL

Look First to the Little Leaks

Goetze's Elastic Corrugated Copper Gasket with Asbestos Lining No. 2

IT'S the little leaks that sap the energy of your power plant—that make you wonder if somebody is stealing coal by the wagon load—that put a big crimp in the "net" for the year.

It's the little leaks at pipe joints and valves that force you to carry higher pressures than you need—that keep firemen shoveling coal into a furnace that seems to burn it to no purpose. And coal is cash.

There can be no real economy in fuel—no matter how good the furnace or how carefully stoked—unless you **get your steam to its work with the minimum of loss**—unless you keep it from getting away through leaky joints.

To put in **ordinary gaskets** is to **waste their cost and the labor of putting them in.** They're **short-lived** and **inefficient.** They usually give out at the most inopportune time—when you're busy—when **every minute** you're shut down means **dollars out of your pocket.**

CUT OUT THIS TREMENDOUS WASTE THIS YEAR, AND HEREAFTER, BY USING GOETZE'S ELASTIC CORRUGATED COPPER GASKETS THROUGHOUT YOUR PLANT.

One of these will do the work that several ordinary gaskets have failed to do; and will last for years when such gaskets crumble and blow out in a few days or weeks.

We prove it by the voluntary testimony of hundreds of plants—some of the biggest, best-managed ones in the country.

We prove it in your plant, without cost to you if the proof is not **absolute**—if it does not satisfy **you.**

We send you Goetze's Elastic Corrugated Copper Gaskets on **ninety days' trial.**

We ask you to **test them under the highest of pressures or temperatures**—on the joints that have given you the most trouble—on which the best of other gaskets have failed.

The more severe the test, the quicker the demonstration that Goetze's Corrugated Copper Gaskets are the most **effective** and the **cheapest** gaskets you can use.

Our new catalogue describes Goetze's line in detail—and the line covers practically all power plant packing needs.

This catalogue will save work for the engineer, money for the owner, and no end of worry for both. It will show how to get **higher efficiency from your present furnace and fuel.** It may help you to avoid indefinitely the expense of a new furnace. It will **pay you** to get a copy of it and study it.

Goetze Gaskets are carried in stock by

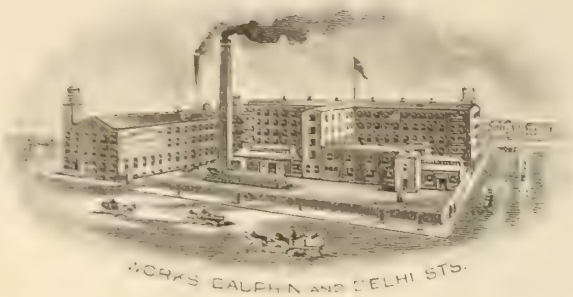
T. McAVITY & SONS, LIMITED

ST. JOHN, N.B.

Branches at MONTREAL	TORONTO	WINNIPEG	VANCOUVER
163 Esplanade Ave.	404 McKinnon Bldg.	Box 331	care A. O. Campbell

MANUFACTURED BY AMERICAN GOETZE-GASKET & PACKING CO.
NEW BRUNSWICK, N.J.

Don't fail to mention this paper in writing to advertisers.



WORKS GALPH N AND DELHI STS.

On Land or Sea

Wherever water is used in steam boilers

LORD'S BOILER COMPOUNDS

are necessary to prevent Scale and Corrosion.

"There are many compounds but only one Lord's."

THE REASON IS

Lord's Compounds are made up specially for each case upon carefully prepared an alysis of the water in use. Only the best of chemicals are used, prepared by our own chemists and special machinery.

Governments and the largest power plants specify

LORD'S

The kind that has given satisfaction for almost fifty years.

Geo. W. Lord Co.

Main Office and Works:
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Agents Wanted for Western Canada.

A Clean Boiler Means Fuel Saved!

And the surest way of keeping your boiler free from scale is to treat your feed-water with

Walker's Electric Boiler Compound

So sure are we that our compound will keep YOUR boilers free from scale without the least injury, that we will willingly

REFUND YOUR MONEY

if it fails to do all we claim for it. Get our price list.

THE ELECTRIC BOILER COMPOUND CO., Limited
Guelph, Ont.

OILS For Engines, Machines, Cylinders,
SUPPLIES Dynamos, etc.
Specialty---Pure Tri-Sodium Phosphate.

Don't Waste Time

or expense cleaning scaly tubes! any money spent in preventing scale is a far more profitable outlay than what it costs to remove the scale after it has formed. Prevent scale by using

INTERNATIONAL
BOILER COMPOUND

But we can't work in the dark; we must find out what your feed water contains before we can mix the compound that will eliminate the scale-forming salts. Express us one gallon of your feed water; we will analyse it *free of charge,* and will forward a TRIAL SAMPLE of our compound guaranteed to banish all your Scale Troubles.

You can make money acting as our agent. Write for details of our offer.

Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

Are You Going to Work Nights, Sundays and Holidays This Year Cleaning Boilers?

Why not cut it out for a change? What's the use of poking around for hours with a mechanical cleaner, taking chances on putting your tubes out of business, at least roughening them so that new scale forms quicker and clings tighter than ever before, and then doing the work all over in a little while? What *is* the use? There *isn't* any use.

Bird-Archer Made-For-You Boiler Compounds Will Clean Your Tubes and Keep Them Clean

They will increase the capacity of your boilers, enable you to make a better showing for economy and cut out the night, Sunday and holiday work.

Bird-Archer Boiler Compounds will do all that, *surely*, *safely* and *without injury to your tubes* because they *are* "made for you"—because they're put up only after our chemists have analyzed a gallon of your feed water and determined *exactly* what conditions are to be met and overcome in *your* case—because their ingredients will attack only the scale and will not affect the iron.

"Boiler Troubles and Their Prevention" tells *why* these statements are true. It tells the whole money-saving story of Bird-Archer Boiler Compounds. But it is more than an advertisement---it's a Scientific Treatise on its subject, worth money to you in the daily practice of your profession. This book is *free to you.* Simply send us your name and address and we will mail you a copy of it at once.

The BIRD-ARCHER COMPANY

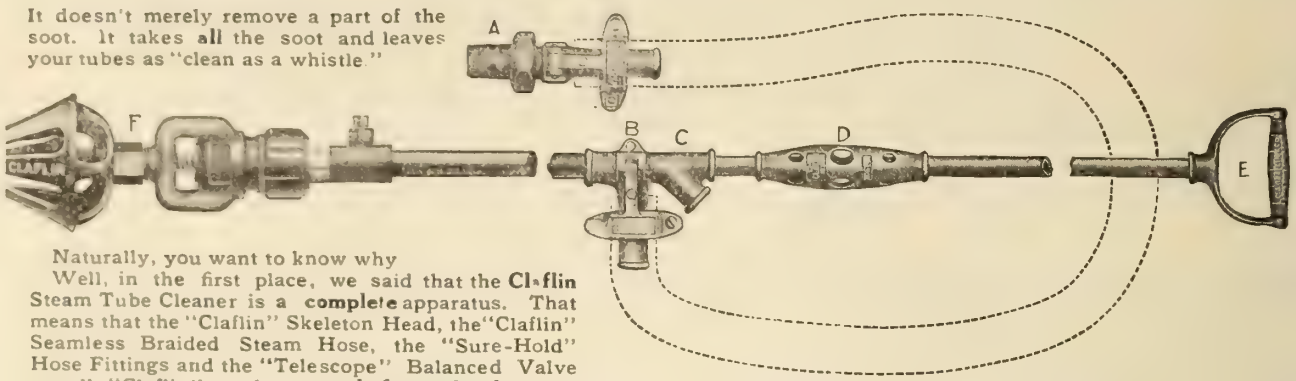
90 WEST STREET, NEW YORK CITY

Canadian Representatives: Lowden & Mead, 13 Bleury Street, Montreal

The "CLAFLIN" Steam Tube Cleaner

IS A COMPLETE APPARATUS FOR REMOVING SOOT FROM BOILER TUBES—AND IT DOES IT TOO

It doesn't merely remove a part of the soot. It takes **all** the soot and leaves your tubes as "clean as a whistle."



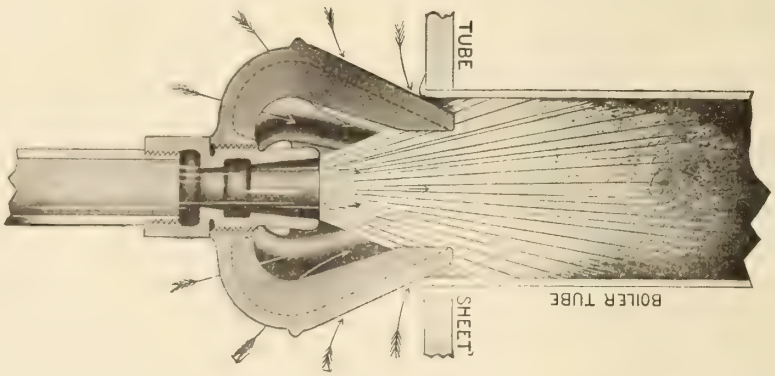
Naturally, you want to know why

Well, in the first place, we said that the **Claflin** Steam Tube Cleaner is a **complete** apparatus. That means that the "Claflin" Skeleton Head, the "Claflin" Seamless Braided Steam Hose, the "Sure-Hold" Hose Fittings and the "Telescope" Balanced Valve are all "Claflin" products, **made for each other** and made to clean tubes as no commonplace contrivance can.

Our Idea of "Completeness"

The "Claflin" Skeleton Head

The "Claflin" Head is different from any other head you ever saw. We made it different in order to make it better.



What WE call a "Head."

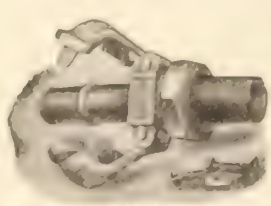
The centre cut shows you the secret of the tremendous cleaning power of the Claflin Cleaner.

That divergent, tapered steam nozzle (steam turbine principle) gives the steam a velocity that is simply terrific, and with the great volume of air which it draws through the Skeleton Head, thus breaking the vacuum, it goes through the tube with a force that sweeps everything before it.

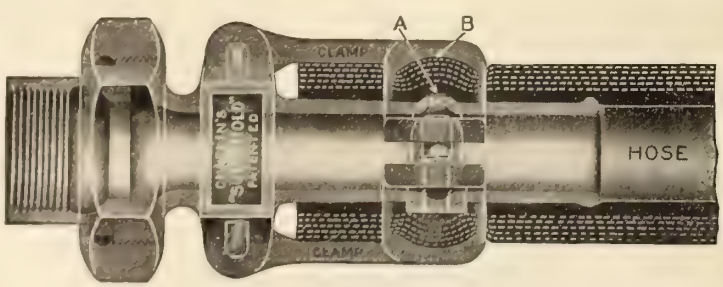
Imagine a swab that fairly fills the tube being shot through it at great speed, and you get some idea of the effect. And remember that this force is so great that it is not nearly spent when the steam rushes out the end of the longest tube in a cloud of soot that it drives irresistibly before it.

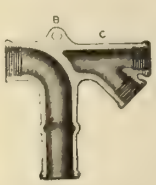
The "Sure Hold" Steam Hose Fitting named themselves

They're anti-trouble fittings. That's just what they are, because they insure you against scalding accidents, law suits and delays.



Our Notion of What a Hose Fitting Ought to be





Sectional View of Handle Hose Fitting. Note separation of steam passage from Handle Connections.

They hold the hose absolutely secure without the slightest injury to it. Hose cannot blow off. Any hose to which they can be attached will burst rather than blow off.

We said something back there about hose bursting. That's another of your troubles that Claflin overcame for you—another reason why he had to have a hose as good as the rest of the Claflin outfit—why he made sure at every point by bringing out

The "Claflin" Seamless Braided Steam Hose

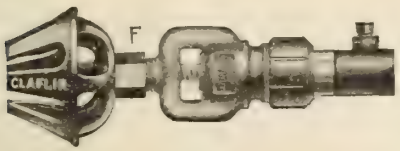
How the "Claflin" Steam Hose is put together.

Circular braided, mind you, not flat woven cotton duck wrapped up. Ply for ply, the "Claflin" Seamless Braided Steam Hose is the strongest, most flexible steam hose made. The Braided construction allows the rubber lining to expand or give when steam hot, instead of doubling up inside.

The 1 in. 4-ply is recommended for 120 lbs. steam pressure—has stood a hydraulic test of over 1,000 lbs. without bursting and can be coiled within a 10-in. circle without kinking.

The Handles of the "Claflin" Cleaner are Tubular and all Metal

Tubular for LIGHTNESS. All metal for STRENGTH and DURABILITY. The Transposable Handle and the Eye for counterbalancing, if desired, make it almost child's play to handle the cleaner, put it exactly where you want it at first try and hold it there without even tiring your muscles.



This is The Finishing Touch Does not interfere with Air passing through the Skeleton head.

The "Telescope" Automatic Balance Valve

If anything was lacking to make the "Claflin" Steam Tube Cleaner practically perfect, we supplied it with the "Telescope" Self-Closing Steam Valve.

Sectional View of the "Telescope" Valve made of Best Steam Metal. Only three working parts; Valve, Seat and Spring.

This valve is the finishing touch, because it enables you to have steam at full boiler pressure confined within a few inches of the tube ends, and a slight push at the end of the Cleaner handle opens Valve and produces a quick and powerful blow—a blow that starts the soot and keeps it going, too. The Valve closes automatically when moved from tube to tube, saving Steam, Dirt and Noise.

Every part a Specialty in Itself---Making the complete Outfit the most perfect apparatus ever made for the purpose intended.

Now don't be content merely to read this and "guess it's a good thing all right, and I'll try it some day." That won't clean any tubes now.

Fill in this Coupon, Mail it to Us To-day and get Our Wide-Open Stringless, Free Trial Proposition

If we can't prove to your absolute satisfaction that the "Claflin" Steam Tube Cleaner does everything we say it does, right down to the last letter in our guarantee, we don't want you to keep it. Anyhow *the trial will not cost you a cent* and you owe it to yourself to fill in that coupon and mail it *now*. The obligation and responsibility are all *ours*. The chance to learn a sure, easy way to save money and labor is all *yours*.

GENERAL CANADIAN DISTRIBUTORS·

Power Economies Limited,

9 St. Nicholas Street
MONTREAL

Maysmith & Lowe
Davies Chambers
VICTORIA, B.C.

Robert Black
7 Home Bank Bldg.
WINNIPEG, MAN.

Norman S. Jarvis
602 Carlaw Bldg.
TORONTO
Phone M. 4625

Send me complete details of the Claflin Ste Tube Cleaner and its component parts

Name .....

Address .....

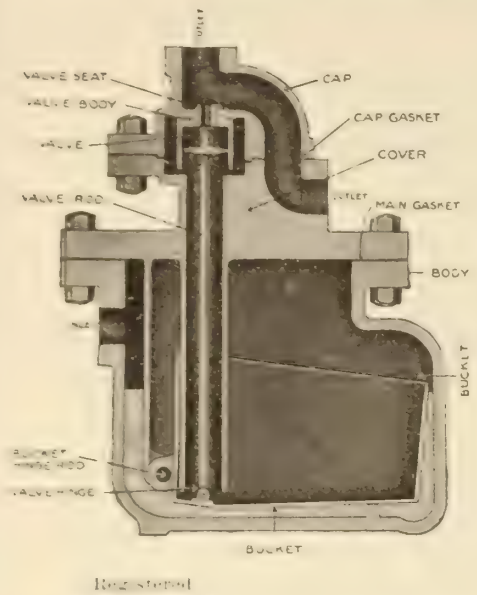
Firm Name of Employer .....

Number of Boilers .....

Type of Boilers .....

Size of Tubes ..... Steam Pressure Carried .....

There are three kinds of Steam Traps—Good, Bad and Indifferent



GOOD traps save your steam.

BAD traps waste steam

INDIFFERENT traps save some of the steam and waste the balance.

You will find

Strong Steam Traps

in the first class. You can find this out for yourself without any possibility of a loss by sending us an order for one or more traps for 60 days' trial. If you don't like them, send them back at our expense, and just remember that on their merits alone we ask your patronage.

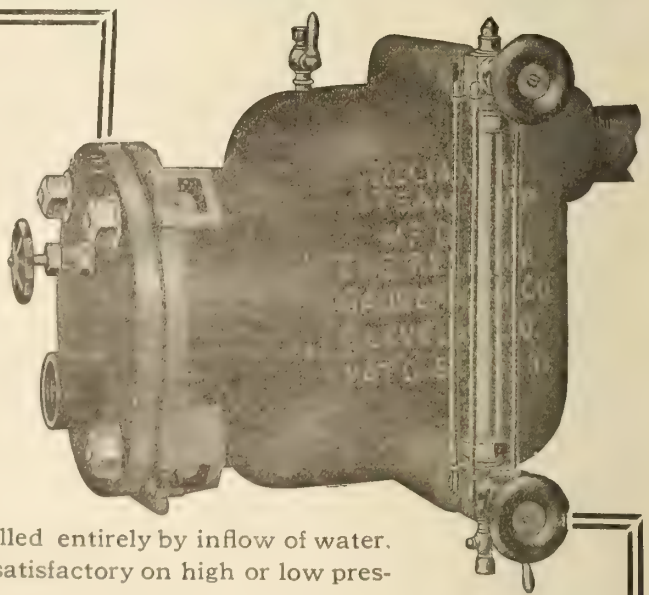
4/S
Trade Mark

The Canadian Fairbanks Co., Limited

Montreal, Quebec, Canada

TORONTO ST. JOHN, N.B. WINNIPEG CALGARY VANCOUVER

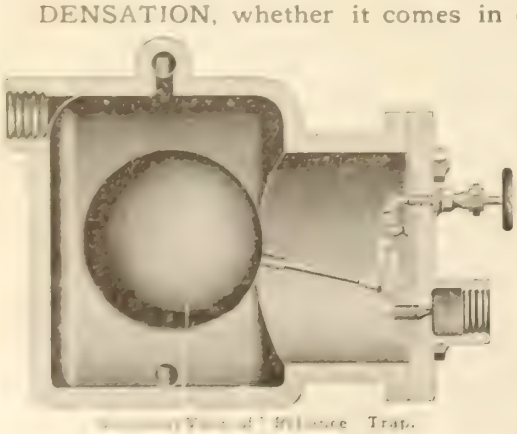
The Acme of Reliability!



You can banish trouble and save the time spent tinkering around your plant, if you are using the reliable trap—the

"Reliance" Steam Trap

It is simple in construction, has no parts to get out of order, and will handle EVERY DROP OF CONDENSATION, whether it comes in driblets or in floods. Controlled entirely by inflow of water, and is equally satisfactory on high or low pressure systems.



Sediment removed by turn of hand wheel.

EACH TRAP AND FLOAT UNCONDITIONALLY GUARANTEED.

Write for Catalogue.

The Reliance Gauge Column Co.

5902 Carnegie Avenue - CLEVELAND, OHIO

Also Manufacturers of "Reliance" Safety Water Column, "Reliance" Lever Water Gauges, "Reliance" Lever Gauge Cocks.

The advertiser would like to know where you saw his advertisement—tell him.

Quality—Efficiency—Reliability

These, together with reasonable cost, have established the reputation of

Mason Reducing Valves, Pump Pressure and Speed Regulators, Damper Regulators, Balanced Valves.

Reilly Multicoil Feed Water Heaters, Condensers and Evaporators—the most compact and efficient.

It is not what you pay for an article, but what the article pays you in return for its cost, that determines its real value. . . . . .

(Genuine) **Ashton** Pop Valves, Relief Valves, Pressure & Vacuum Gauges, Alarm Gauges.

Berry Safety Automatic Boiler Feed Control the simplest and best.

France Metallic Packing
SOLD UNDER 3 YEARS' GUARANTEE

Bundy Steam Traps and Separators

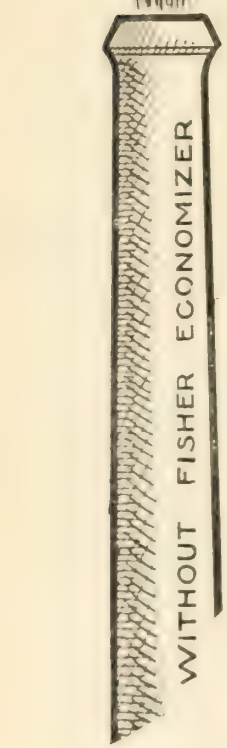
We design complete systems for returning condensation direct to the boilers, and we can effect economies in most steam plants.

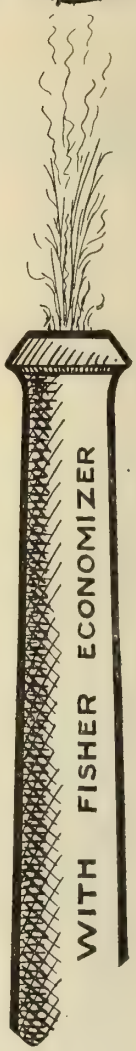
Catalogues and full information are at your disposal.

H. L. PEILER & CO., 52 St. James Street, MONTREAL
404 McKinnon Bldg., TORONTO

100% STEAM TRAP EFFICIENCY
¶ MOREHEAD STEAM TRAPS operate on a principle that insures the complete saving of the heat units represented in the condensation from the steam line returns.
¶ The condensation from any steam heating or power apparatus must be removed. The quicker the condensation is removed the dryer and more effective will be the steam lines. The condensation is pure water and HOT; it is the greatest extravagance to waste it.
¶ The most effective way to utilize the heat content is to deliver it into the boiler before it vaporizes. In no other manner can the condensation be handled so quickly and with the same economy as with a Morehead Trap.
¶ All about it in the "Trap Book." - Write.
MOREHEAD MFG. COMPANY
DETROIT, MICHIGAN.
¶ This illustration shows one of eight Morehead Steam Traps installed at the plant of the McKeesport Tin Plate Company, McKeesport, Pa.

Dont let your money go up in smoke





THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?
¶ About 6 per cent.; the rest is wasted.
¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?
¶ Not over 10 per cent.; often less.
¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.
¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.
¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.
¶ This should be easily done.
¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.
¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.
¶ We save money for the factory owner and railway.
¶ We save the fireman much hard and dirty work.
¶ We save the black smoke which pollutes the air.
¶ We reduce your ashes and clinkers half.
¶ We increase and maintain steam to a degree which is impossible without the economizer.
¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

MONTREAL
Gerald Rowe, 187 McGill Street
Phone Main 811

OTTAWA
569 O'Connor Street
Phone 4494

WINNIPEG
310 McGreevy Block
Phone Main 2750

The advertiser would like to know where you saw his advertisement—tell him.

MILLIONS WASTED

BY USERS OF "GENUINE" BABBITT

The high price of tin, which is controlled by manipulators, who can juggle the price up or down to suit their convenience, should cause users of "Genuine" Babbitt to consider seriously the advisability of adopting some cheaper suitable substitute.

A "Genuine" Babbitt should contain about 88 per cent. tin. It is a notorious fact that tin is a very dry metal, and it is by no means what it is claimed to be as a bearing metal, as its anti-frictional qualities are comparatively very poor. A Genuine Babbitt will not fill in the interstices and condition the shaft as Magnolia Metal does. Unless a "Genuine" bearing is kept flooded with oil it is liable to become hot and run out, whereas a Magnolia-lined bearing, under the same conditions, will more than likely run for years without any perceptible rise in temperature, on very scant lubrication. Unless a bearing metal is poured in a *separated condition,* the weight of the shaft will rarely, if ever, cause it to squash. It is usually frictional heat that causes this trouble, to which "Genuine" Babbitt is very susceptible, and, therefore, it naturally follows that a high-grade anti-frictional metal like Magnolia is very much more dependable. Not only is Magnolia superior anti-frictionally, it will actually withstand 19 per cent. greater compression test than "Genuine" Babbitt. Thousands of practical users have made this discovery and are using Magnolia in preference to all other bearing metals.

Some years ago we had Dr. Torrey, Chief Assayer of U. S. Mint, New York, test all the leading "Genuine" Babbitts then on the market. Every one of these Genuines ran out in from five to fifteen minutes under pressures ranging from 500 lbs. to 1,400 lbs. per square inch, whereas Magnolia ran at the same speed—1,600 revolutions per minute—for eighty minutes, up to 2,000 lbs. per square inch, and came out of test in a perfect, highly-polished condition. It is very difficult to run the temperature of a Magnolia-lined bearing up to a destructive point.

Every civilized country of the world has contributed its quota of testimonials regarding the splendid results obtained from using Magnolia Metal. If you are using Genuine or any other bearing metal, we ask your careful consideration as to the merits of Magnolia. Magnolia is made of selected virgin materials of the best quality, which are still further cleansed, and graphite incorporated into it. Magnolia is idealic in all of the good qualities that go to make an all around first-class bearing metal.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

No. 225 St. Ambroise Street, MONTREAL

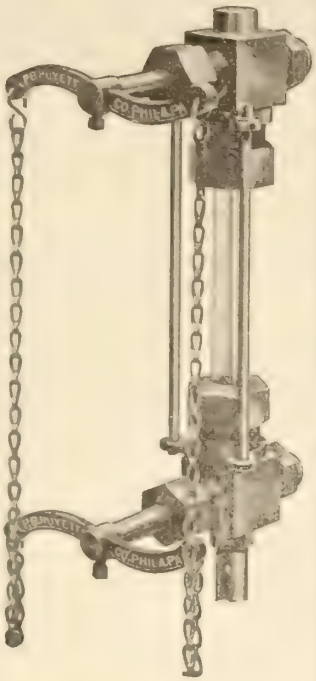
New York Chicago

SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK, containing 680 pages, treating on over two thousand Engineering and Mechanical Subjects, brought up to date. We offer this valuable reference work at the low price of 40c postage prepaid. Address Montreal office.

You Can Save Boiler Room Troubles

by using the

"P.B.H." Quick-closing Water Gauge



An accident insurance against scalds and burns.

When glass breaks, a pull of the chain instantly shuts off both steam and water. Body is extra heavy and structure perfect. Made of best steam metal, with extra large nuts for extra heavy washers.

SENT ON TRIAL

The "P.B.H." Quick-closing Self-Opening Gauge Cock

Simple, efficient, economical and quickly repaired. Guaranteed leakless for one year.

SENT ON TRIAL

The "Tornado" Steam Boiler Tube Cleaner

does its work better, more quickly and more economically than any other. Blows soot out through the longest tubes, because the air injected by a small volume of steam carries no moisture to wet it.

SENT ON TRIAL

The Paul B. Hu yette Co.

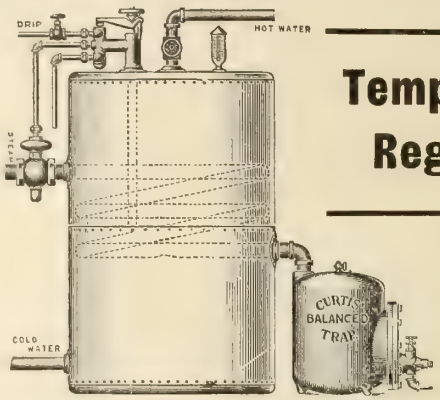
1414 Betz Bldg, Philadelphia, Pa., U.S.A.

Agents for Western Ontario and Co., 186 Queen St. E., Toronto

Montreal, Canada

Write for Catalog fully describing our specialties

Curtis Engineering Specialties



Temperature Regulator

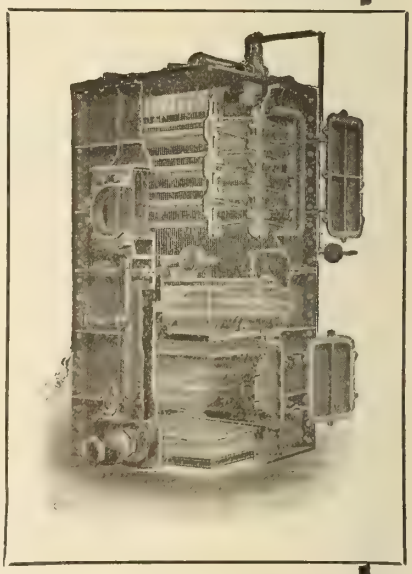
For controlling the temperature of hot water in hotels, hospitals, etc.

SEND FOR CIRCULAR AND 1910 CATALOGUE

JULIAN D'ESTE COMPANY

24 Canal Street, - Boston, Mass.

More Power at Less Cost!



Here's a proposition to diminish working costs that must surely appeal to YOU!

Will you investigate the merits of the

WEBSTER

Feedwater Heater, Purifier and Filter?

It makes use of all condensations and waste steam, and will positively rid your boiler of scale by removing all scale-forming elements from your feedwater. Using pure water means getting every ounce of power out of your boiler with a *smaller* amount of fuel.

Our descriptive literature has many points of interest for you! Send for it TO-DAY.

DARLING BROS., LIMITED

Montreal Toronto Winnipeg

Vancouver, B.C., Frank Darling, Agent

Read This Good Advice About Oil In Boilers

The Fidelity & Casualty Co., like other boiler insurance companies, strives to protect its customers and itself from losses. The recommendations of its engineers are based upon life experience, are impartial and are conscientiously thought to be profitable to the boiler owner in the long run.

Under the headings "Steam Boilers" and "Oil Removal" in their book "Prevention of Industrial Accidents" this quotation appears:

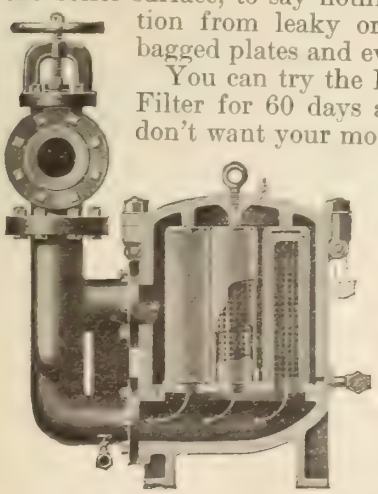
"Wherever the exhaust steam comes into contact with the feed water, or oily drips are returned to the boiler, an efficient oil separator or filter should be installed.

"Probably the most effective filtering medium is linen terry, which is used in some of the filters now on the market. This strains the water as it passes from the feed pump to the boiler. The terry cloth may be removed, boiled in soda, and used again."

Oil deposits, long before they become dangerous, are costly on account of wasted fuel and additional repair expense.

THE BLACKBURN-SMITH FEED WATER HEATER AND GREASE EXTRACTOR is the best means of retarding oil in feed water, and is superior to other types of filtering apparatus in that it utilizes linen terry as recommended above. This apparatus is doubly effective, for it affords double filtration through separated cloths. The substitution of fresh for foul cloths is the work of less than ten minutes, even in a 4500 H. P. unit.

Where oil is present this filter is a paying proposition if used for no other purpose than maintaining high heat-transmitting efficiency of the boiler surface, to say nothing of the protection from leaky or blistered tubes, bagged plates and even explosions.



You can try the Blackburn-Smith Filter for 60 days at our risk. We don't want your money if the results are not up to our every claim.

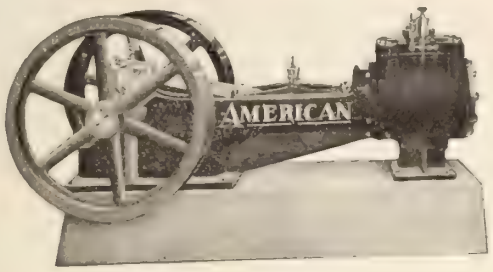
Let us refer you to plants where you can see for yourself what this apparatus is doing.

Ask for book, "Feed Water Filtration."

JAMES BEGGS & COMPANY

39 WARREN ST., NEW YORK

Sole Canadian Sales Agents: Eadie-Douglas, Limited
Montreal Toronto Winnipeg Vancouver Ottawa Quebec



MARSH AND AMERICAN

STEAM AND POWER DRIVEN

AIR COMPRESSORS

FOR air lift systems, pneumatic tool service, machinery cleaning, and in fact every service where compressed air is used. these compressors have established an enviable reputation for EFFICIENCY, RELIABILITY and LOW COST OF MAINTENANCE.

They are designed according to the latest engineering practice and can be depended upon to work to full capacity under all conditions.

The Marsh Steam-Driven Air Compressors are equipped with the famous Marsh Self-regulating Steam Valve which proportions the amount of steam consumed to the work done by the air end, and is especially adapted to air compressor service.

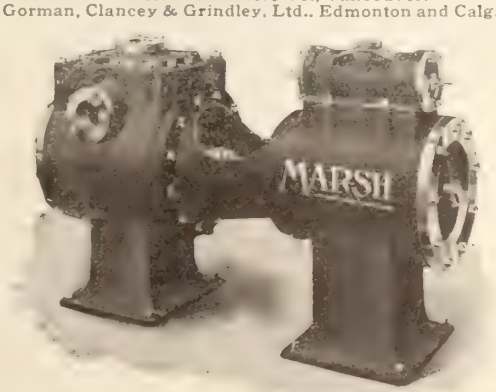
LET US FIGURE ON YOUR COMPRESSED AIR PROBLEMS

Write to-day for booklet describing our line of compressors and their uses.

American Steam Pump Co.

Battle Creek, Mich.

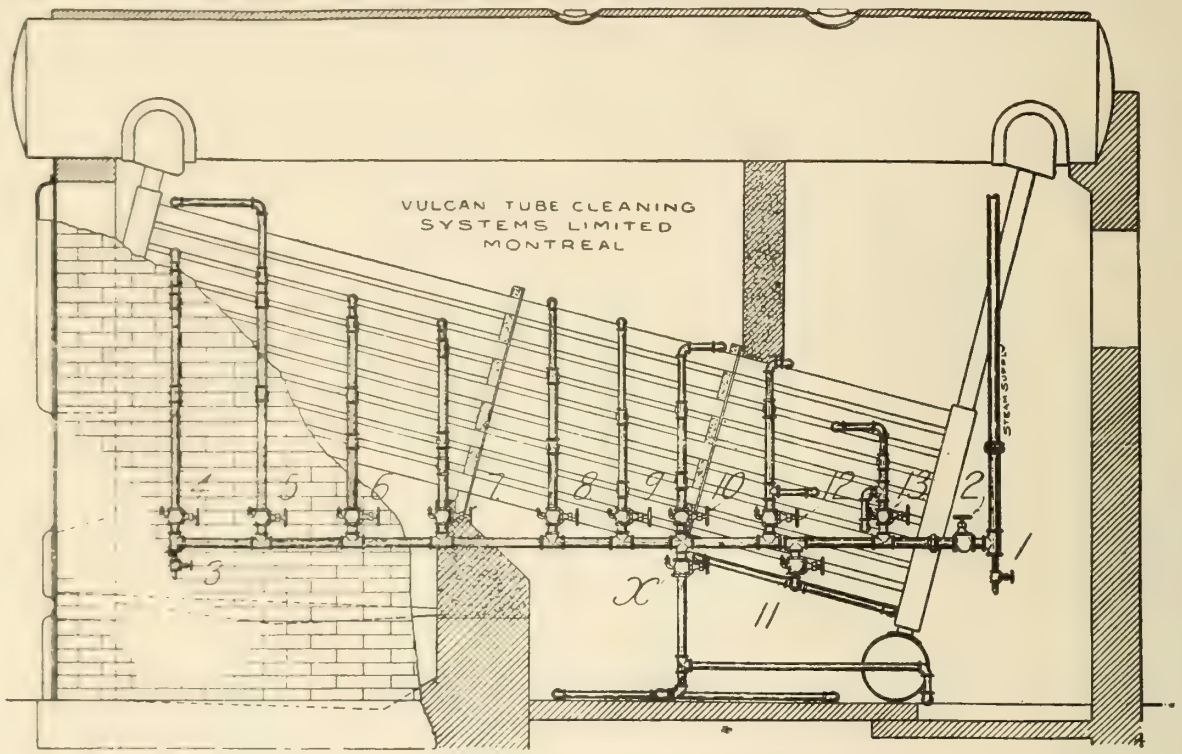
CANADIAN AGENTS:
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London.
Stuart Machinery Co., Winnipeg.
Hallman & Peniston Machinery Co., Vancouver.
Gorman, Clancey & Grindley, Ltd., Edmonton and Calgary



The advertiser would like to ***know where you saw his advertisement—tell him.***

A CLEAN BOILER MAKES A NOISE LIKE A DIVIDEND

SAVES FUEL SAVES LABOR INCREASES BOILER CAPACITY



VULCAN SOOT CLEANER METHODS APPLIED
TO A BABCOCK & WILCOX BOILER

THE VULCAN SOOT CLEANER is a stationary system of piping (applicable to all types of water-tube boilers) operated by valves at the side of the boiler. Long perforated pipes are located so as to send jets of steam between every row of tubes blowing with the draft. In parts of the first pass of tubes, special heavy nozzles are used, which are most effective.

SOOT on a water-tube boiler DEFIES removal by hand blowing.

THE VULCAN SYSTEM sweeps the heating surface from end to end, the soot being driven from the front end of the boiler to the rear end into the combustion chamber where it belongs, and thence, if desired, up the stack. With hand blowing, the little soot that is reached is not removed, simply transferred,—blown from the near to the far side of the boiler. Inspect any hand blown boiler at the end of a month's run, and note for yourself the great quantity of soot that is present,—there may be a wagon-load there.

You can FORCE some heat through SOOT, but consider the loss? Why attempt to heat through soot unnecessarily?

THE VULCAN SOOT CLEANER IS THE ONLY SOLUTION TO THE SOOT PROBLEM.

THE VULCAN SOOT CLEANER PERMITS OF FREQUENT AND ABSOLUTELY THOROUGH CLEANING.

You will be interested in our booklet, "Economical Steam Production." We will send you a complimentary copy on request.

Give us the following information—type of boiler—pressure—number of tubes high—we will send you without charge a proposal for your consideration. Write to-day.

ALL INSTALLATIONS ARE GUARANTEED, AND YOU HAVE 30 DAYS' TRIAL.

Vulcan Tube Cleaning Systems, Limited

General Offices:
204 ST. JAMES ST., MONTREAL

Western Agents:
J. L. NEILSON & CO., 602 Main St., WINNIPEG

The advertiser would like to know where you saw his advertisement—tell him.

"THE Cyclone"

Shaking and Dumping Grate Bar

Two Reasons why the "Cyclone" leads all other Grates!

1. Its greatly improved shaking apparatus passes ALL the ashes through the grate.

2. The large air space between its bars (68 per cent. of total area) has greatly increased the production of steam, and economized fuel consumption.

A V-shaped cut in the trunnion, working in an irregularly shaped socket on the side bar, renders the shaking very much more vigorous than before. No ashes will cling even to the centre of the grate—the place where they are usually found.

The "Cyclone" is the only Grate from which MAXIMUM RESULTS can be obtained with the CHEAPEST KINDS OF FUEL. It locks level, will never warp, and cannot get out of adjustment.

We have scores of appreciative letters from leading firms.

Read the one reproduced:—

Canadian Boiler Equipment Co.
Toronto.

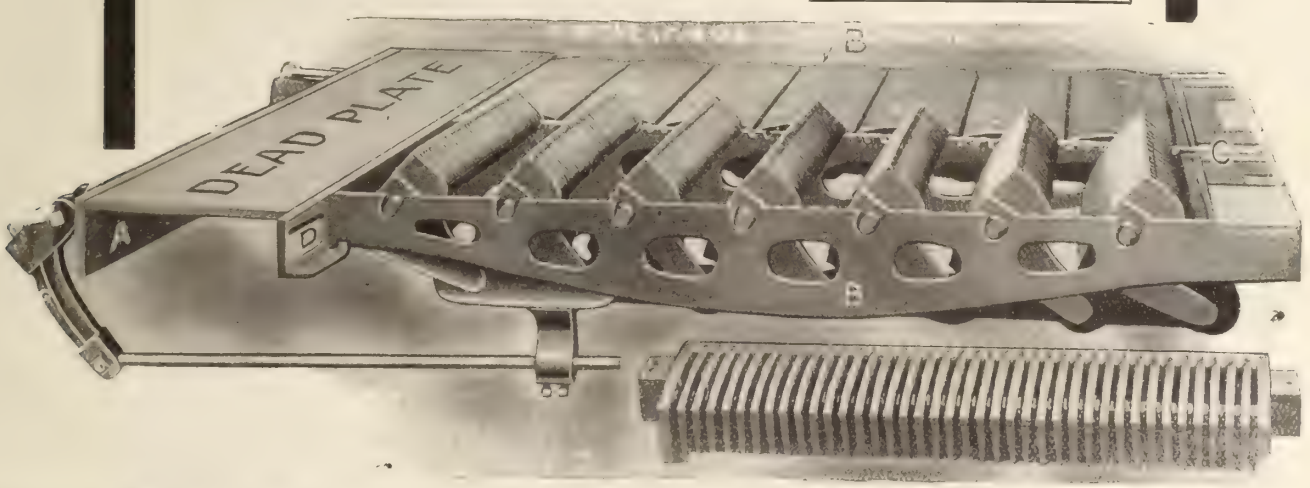
GENTLEMEN:

We are sending you to-night, through our Head Office in Montreal, an order for another set of Cyclone Shaking and Dumping Grate Bars for one of our boilers. We are glad to say that we have no reason whatever to regret the installation of the first set of these bars We have had them in operation several months, and we find that we get more perfect combustion and much better fires and greater economy in our use of coal with these bars than we have had from any system of firing that we have tried at this mill. It is our intention, during the coming summer months, to complete the installation of these grate bars under our other four boilers

Yours truly,

The Canadian Colored Cotton Mills Co., Ltd., St Croix Mill

J. W GRAHAM, Manager



Canadian Steam Boiler Equipment Co., Limited

(Sole Manufacturers for Canada)

186 Queen Street East, Toronto

AGENTS

ST. JOHN, N.B.—F. W. BLIZZARD, Canada Permanent Chambers.

MONTREAL—JOHN G. ABRAHAM, 2844 Mance St.

HAMILTON—ROBT. FITZSIMMONS, 8 Grove Street

WINNIPEG—VULCAN IRON WORKS, LTD.

Don't fail to mention this paper in writing to advertisers.

Let Us Help You Get Your License

We will send you, **FREE**, a Book of "Questions and Answers to Engineering Examinations," if you will send us your name and address, that of your employer, and of your dealer. Thousands of engineers in the "States" have been helped by this book.

Write for Your Copy To-day.

DANIELS' ROD PACKING **P.P.P.** **"Regular" "Special" "Marine"**

"Regular"

is positively **self-adjusting**, whether the steam pressure be 300 pounds or but 5 pounds.

Scientific tests show Daniels' P.P.P. to be without an equal. It saves the engineer work, and the employer money.

Send for a **FREE** copy of "The Story of Some Friction Tests," also **FREE** sample of P.P.P., showing construction.

Address: Dept. 24-B

Quaker City Rubber Co.

Manufacturers of Mechanical Rubber Goods

Philadelphia, Pa., U.S.A.

Chase that scale from your boiler and prevent it re-forming, by treating your feedwater with

Potato Scale Boiler Cleanser

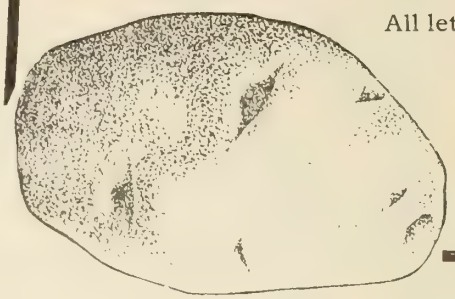
It will positively save a large part of your fuel bill, and is guaranteed not to injure tubes, shell or connections.

Express me one gallon of your feedwater and I will send you a compound guaranteed to free your boiler from scale and keep it free.

Get in touch with me to-day.

Sole Agent in America

C. C. SNOWDON



All letters to Calgary

CALGARY,

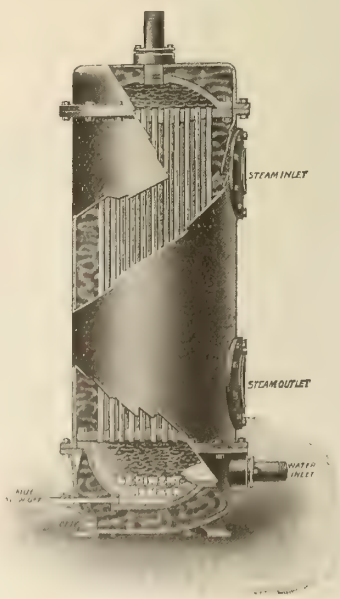
ALBERTA

CANADA

Mackie Patent Heaters

"Made in Canada."

The tube portion of this heater is not attached to the shell. Allowance for free expansion and contraction makes it the most durable heater on the market.



Goulds Pump Company

National Trust Bldg., TORONTO

Coristine Building, MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

Where Other Packings Fail

PREMDURO FLEXIBLE METALLIC PACKING

Meets Every Requirement!

The increasing pressures of modern practice have only, too plainly, emphasized the defects of rubber, canvas and asbestos soft packings, and of the very many different kinds of metallic packings, yet the perfect packing has been a long time in coming.

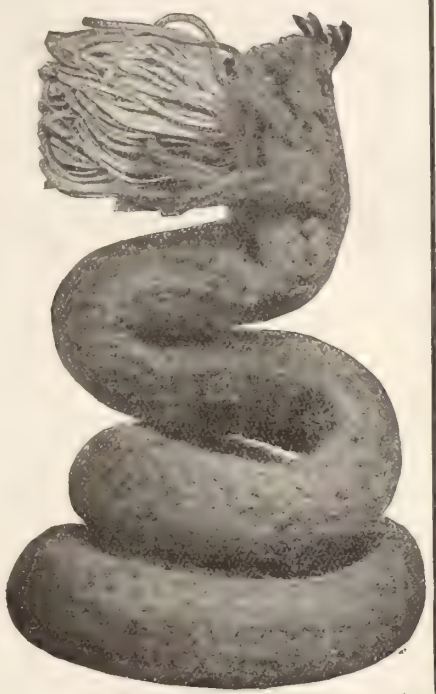
For years the ideal sought after has been packing that is at once durable, absolutely non-heating and non-scoring, self-lubricating and impervious to high pressures and temperatures.

We confidently recommend "Premduro" Packing as adequately fulfilling these conditions.

"Premduro" contains no rubber, asbestos or other material that scored rods or high pressure can affect. Composed of numerous triangular soft metal wires of special composition, the packing readily shapes itself to the scored or smooth surface. It is very simple to insert and costs less that any other efficient metal packing.

Give "Premduro" a thorough service test, and if it will not do all we claim for it, we will cheerfully refund your money.

Write for samples, literature and prices.



Premier Engineering & Manufacturing Company

25 Broad Street, New York

The International Supply Co. of Montreal, 140 Mansfield Street, Montreal, Agents for Montreal and Quebec Province, Ontario, British Columbia and Manitoba.

Works at Hamilton, Canada.

The GARLOCK FACTORY

is the largest and only plant of its kind in Canada, devoted exclusively to the manufacture of the celebrated

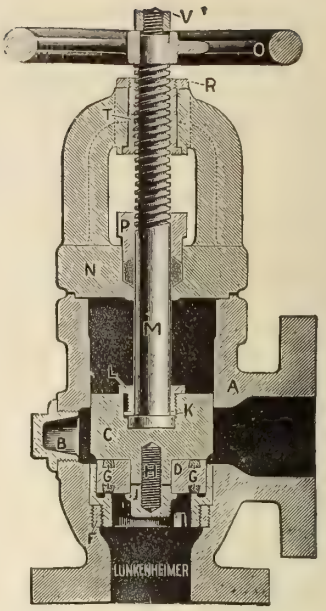
Garlock Packings and Pipe Coverings

Permit us to quote on your requirements.

THE GARLOCK PACKING CO.

Toronto **HAMILTON** **Montreal**

LUNKENHEIMER "DURO" BLOW-OFF VALVES



Are guaranteed for 250 pounds working pressure. The cast iron used has a tensile strength of 25,000 pounds per square inch, and the bronze used contains a high percentage of copper and tin. One of the principal advantages in the design of these valves lies in the construction of the seat and disc which provide SELF-CLEANSING SEATING SURFACES, and any scale or dirt that may lodge on the face of the seat will positively be washed off before the disc is firmly seated, thereby insuring a PERFECTLY TIGHT VALVE.

The disc is DOUBLE SEATED and can be REVERSED or RENEWED when worn. The SEAT is also RENEWABLE, as also are all other parts of the valve subjected to wear.

WRITE FOR CATALOGUE

MOST supply houses sell them—Yours CAN—if they DONT or WONT—tell US

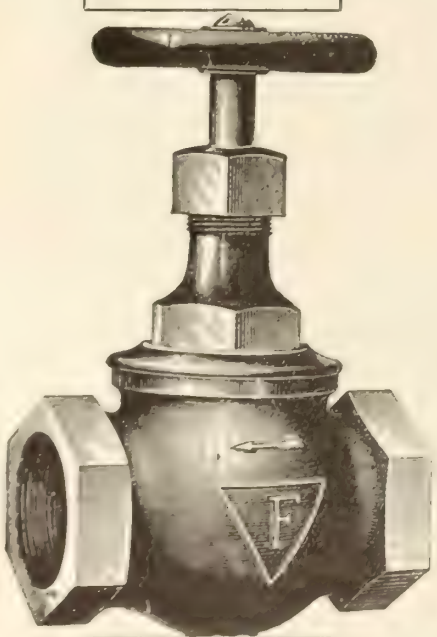
THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the world.

General Offices and Works—**CINCINNATI, OHIO, U.S.A.**

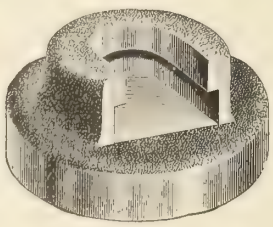
NEW YORK, 64-68 Fulton Street —***BRANCHES***— CHICAGO, 32 Dearborn St., cor. Lake
LONDON, S.E., 35 Great Dover Street.

STANDARD
125 Lbs.
Pressure



EXTRA HEAVY
175-250 lbs.
Pressure

FAIRBANKS'

Renewable  Disc

VALVES

Fairbanks' Renewable Disc Valves

are well and simply made and have many excellent features They are tight and remain tight under the most severe service. The disc is loose on the spindle, allowing it to come to an even bearing on the seat, and it can be easily replaced in a few minutes, making the valve as good as new. The valves are heavy and doubly strong owing to correct distribution of metal.

The Canadian Fairbanks Co., Limited

Fairbanks Scales—Fairbanks-Morse Gas Engines—Safes—Vaults

Montreal St. John, N.B. Toronto Winnipeg Saskatoon Calgary Vancouver

Type "K"

IRON BODY BRONZE MOUNTED

Gate Valves

Tested to 300 pounds hydraulic pressure.

Elliptical in design.

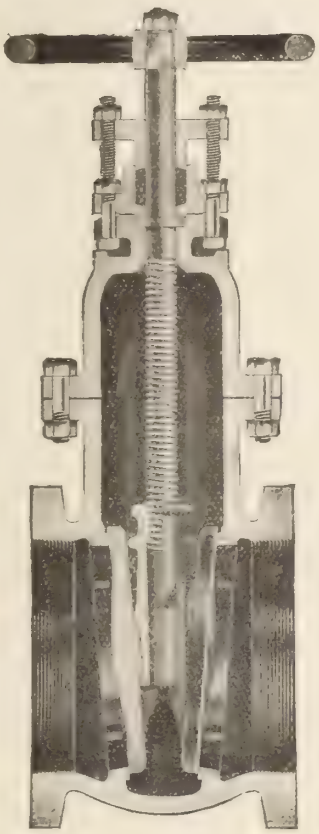
Double Compensating Bronze Faced Discs.

Can be re-packed while under pressure and wide open or closed.

Parts interchangeable.

Discs cannot jam.

Possess wide margin of safety.



Suitable for 125 pounds working steam pressure.

Design insures great rigidity and strength.

Heavy bronze seat-rings screwed into body and renewable.

Bronze disc-rings forced into double-grooved recesses in discs.

Can be operated in any position.

Handsome appearance.

Dependable in service.

A Thoroughly Reliable Gate Valve

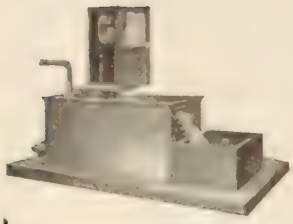
A comparison with other Gate Valves is invited as regards design, material, workmanship and price

Stocked by Jobbers and Dealers Everywhere.
Send for Type "K" Booklet.

Jenkins Bros., Limited

Sole Manufacturers

103 St. Remi Street - MONTREAL



THE
"LEA"
RECORDER

"Self Contained Apparatus" for measuring

BOILER FEED-WATER
AIR PUMP DISCHARGES
and other flows, by means of the V notch.

Sole Canadian Agents
Drummond, McCall & Co.
MONTREAL

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

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W. C. McGHIE,
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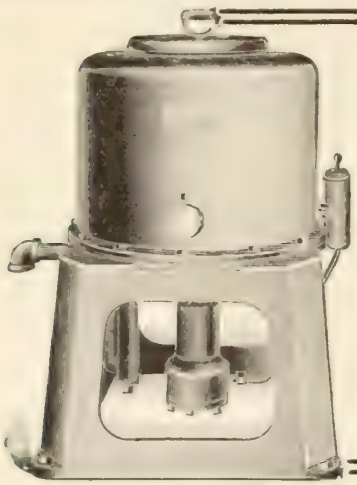

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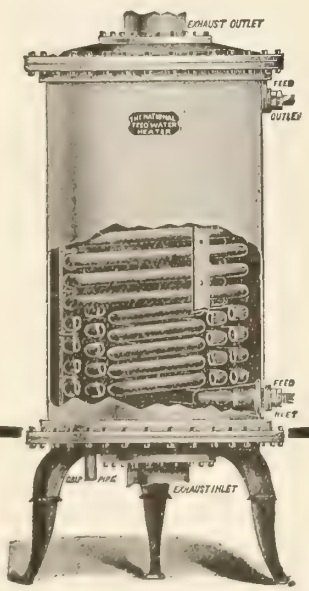

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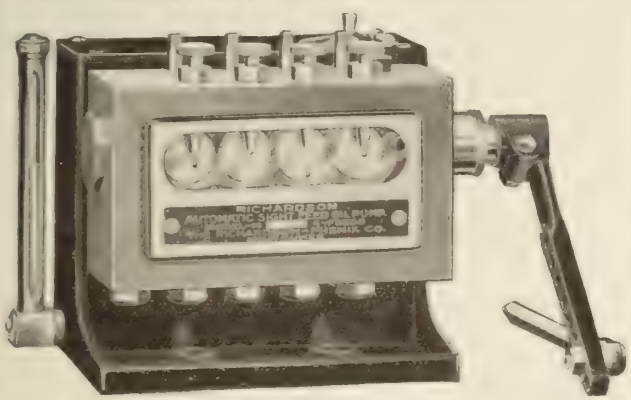

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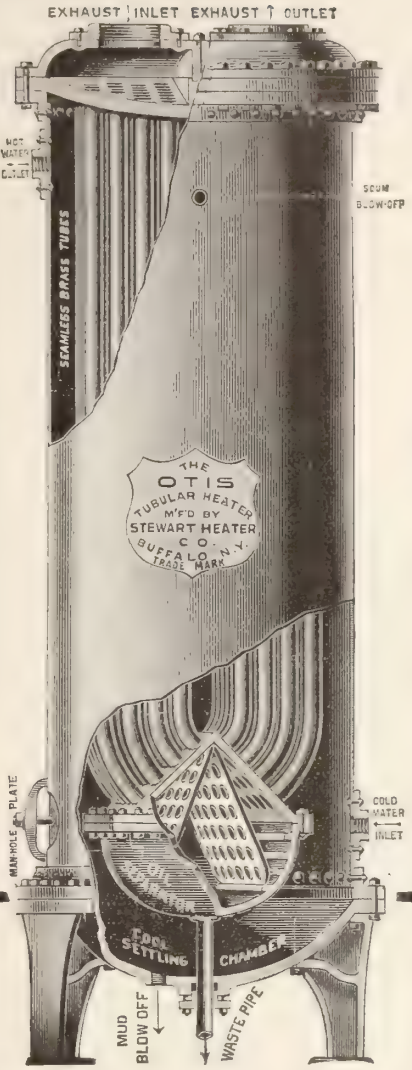

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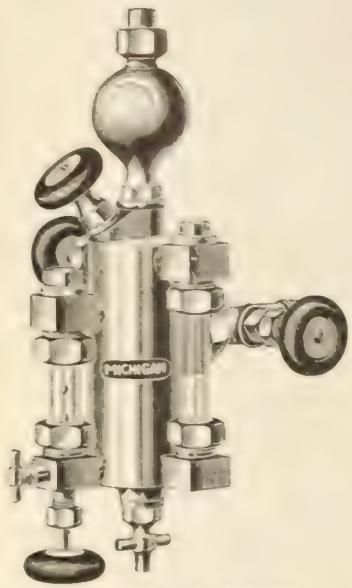

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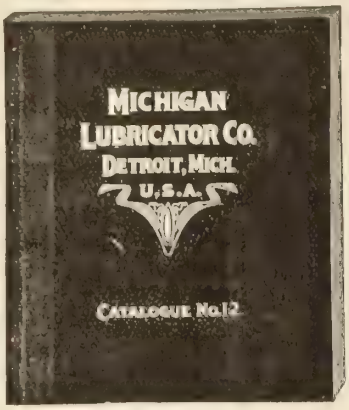

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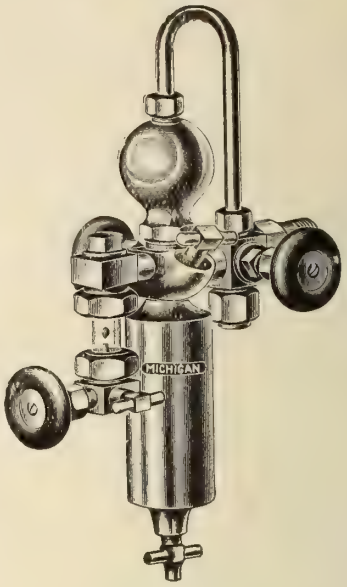

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Detroit quality has resulted in nine-tenths of the prominent engine builders furnishing Detroit Lubricators with their machines.

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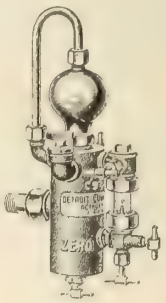

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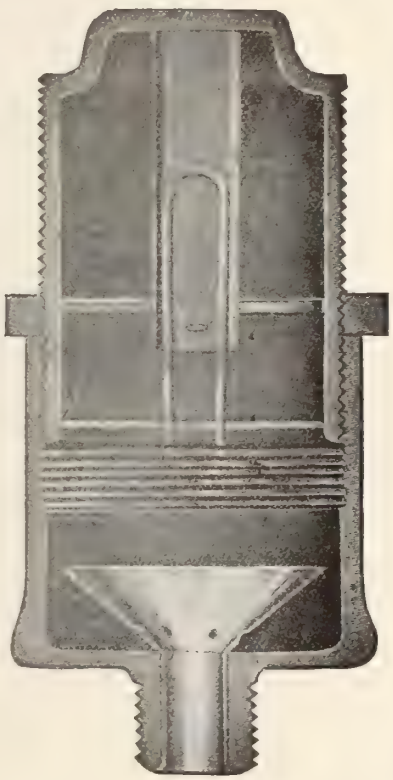

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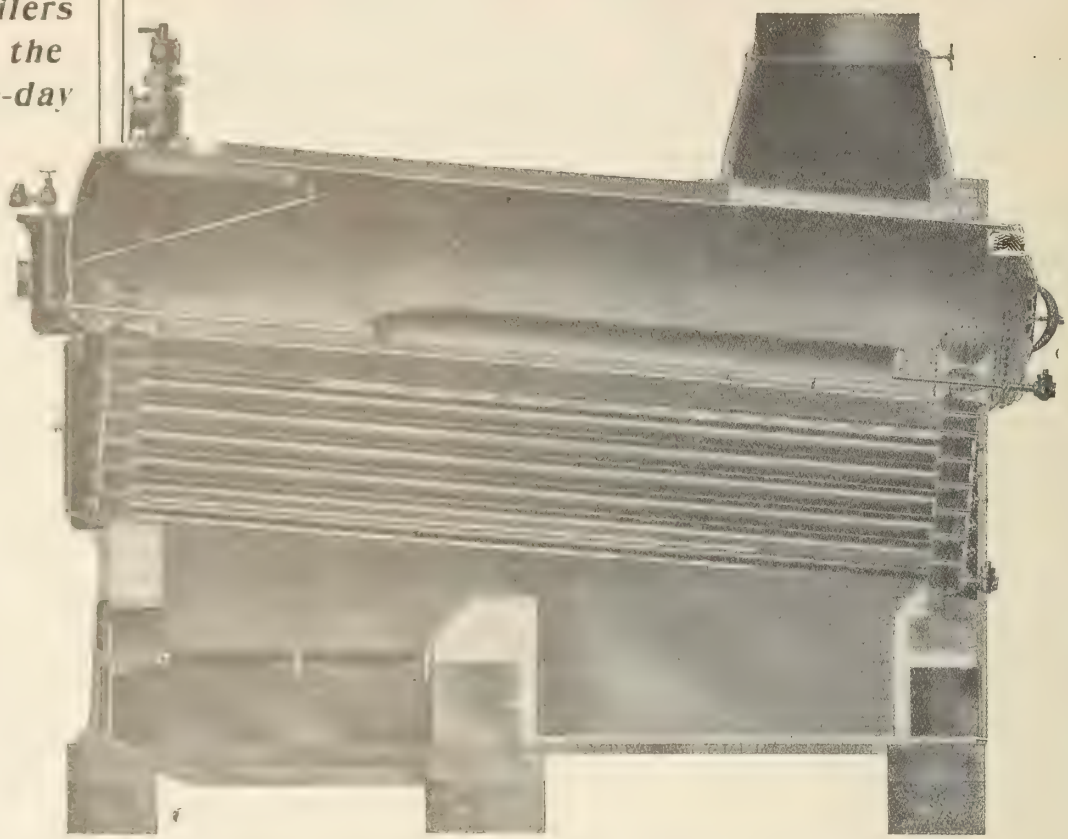

These are three leading features which have contributed to the marked superiority of the

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Manufactured and Guaranteed by

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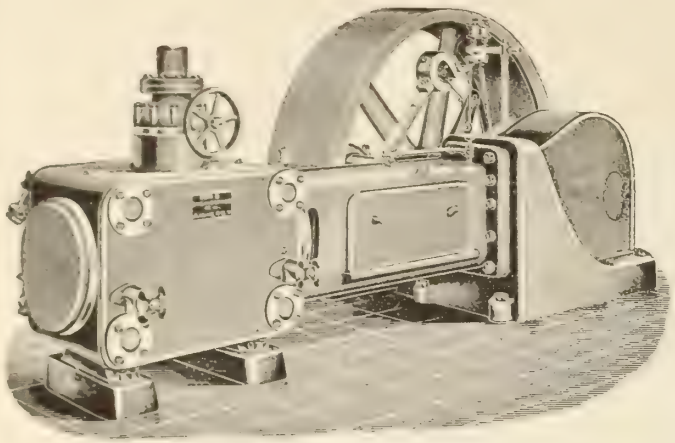

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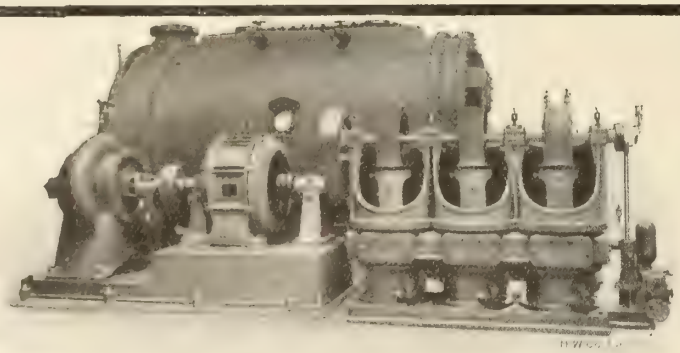

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Barometric Low Level Jet or Surface

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The Canadian Boving Co., Ltd., 164 Bay St.

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We can guarantee prompt shipment; our plant is especially equipped for handling BIG, HEAVY Marine Work. We will gladly furnish detailed specifications, blue prints and prices at your request.

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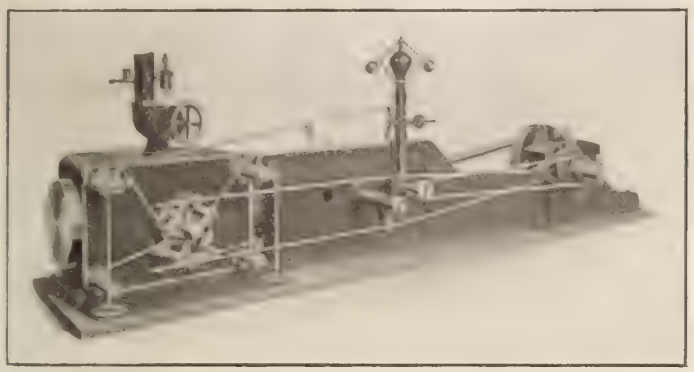

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Warehouses and Agencies at Montreal, Que., St. John, N.B., Calgary, Alta., Winnipeg, Man., Vancouver, B C.

We are as full as a tank with tank talk

But we know busy men like condensation, so we will content ourselves by stating that

We make Iron and Steel Tanks of all kinds

One of our specialties is an all-welded transformer tank without rivets or seams.

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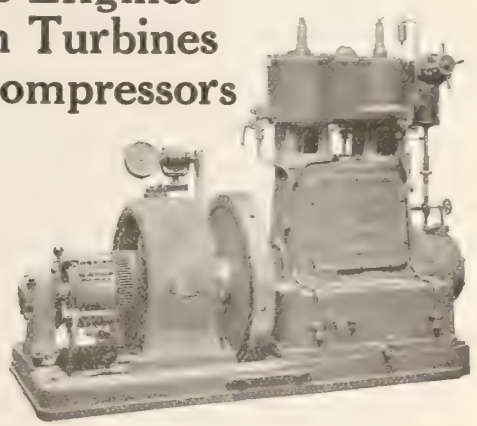

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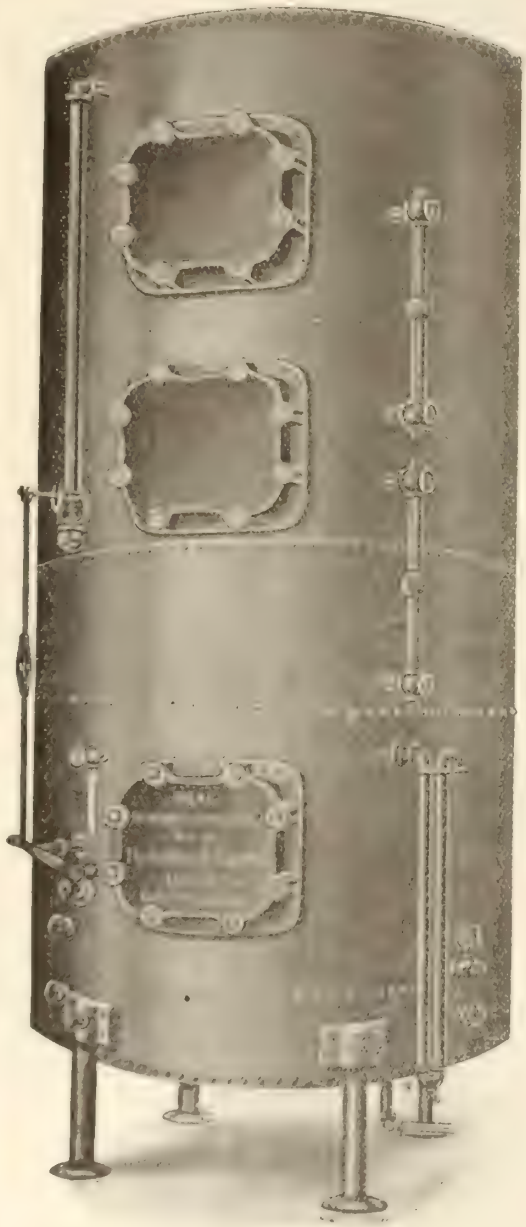

Effectively extracts all oil and grease from exhaust steam.

Removes all carbonate scale-forming matter from feed water.

Delivers feed water to boiler at nearly boiling temperature.

So constructed that all parts are easily accessible.

Material used reduces cost of repairs to a minimum.

This heater is designed to make its installation a good investment rather than merely an expenditure.

In other words, it will quickly pay for itself.

Ask for our catalog No. 19, and we shall also be glad to give you any information you may require.

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Ask for Catalogues, Prices and All Information.

Boiler Design, Construction, Operation, Repairing and Inspection

By H. S. Jeffery

THE engineer in charge of a boiler or boilers occupies a peculiar position. Both the boiler designer and the boiler builder frequently have different views on the same subject; their views many times differing from those of the operating engineer.

(1) The operating engineer is chiefly interested in obtaining the maximum efficiency from the minimum expenditure, and in the safety and up-keep of the boiler or boilers. The efficiency, the safety and the up-keep of a boiler are not subjects remotely related to each other; they are as closely related as are three adjoining links of a chain.

Essentially, for an operating engineer to be successful, literally and not figuratively speaking, he should know the underlying or fundamental principles of boiler designing, constructing, repairing, inspecting and operating.

The points considered by the designer in designing a boiler are most important

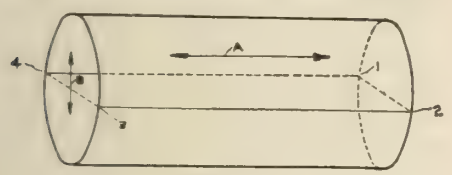

Fig. 1.—

to the operating engineer. The boiler should be designed so as to permit proper circulation of the water; to permit the boiler to be easily inspected and cleaned; to prevent undue stresses upon some members and insufficient stresses upon other parts; to permit repairs to be quickly and cheaply made; and the proportion of parts to be such that the boiler will be a free steamer.

(2) The construction of the building of a boiler is, of course, performed by boilermakers, and not by operating engineers. Nevertheless, the operating engineer should be acquainted to some degree with what is practicable; of the effects of certain operations, and the probable after-effects; able to draw specifications and cite what is desired. and be conversant with boilermaking sufficiently to know the need or reason of certain requirements.

Any boiler, whether used or not, will deteriorate. The deterioration is in the form of wasting and the wearing out of the boiler, both internally and externally, such as pitting, corrosion, blisters and grooving, all of which means the repairing of the boiler, sooner or later. The essential part of repairing a boiler is to replace the defective part without reducing the strength of the boiler at that point any more than necessary,

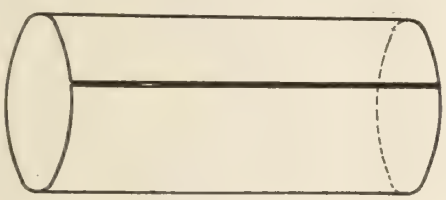

Fig. 2.—

and, of course, applying the patch or new member in a manner to make the boiler as serviceable or as near as serviceable as formerly.

The foregoing can best be accomplished by the operating engineer understanding the underlying principles of boiler design and construction. This being the age of specialists, many of those engaged in boilermaking are not well posted on the forces acting upon the boiler. The riveter will understand fully about riveting; the flue man about the installation of flues, and others thoroughly acquainted with their respective branches, but the foregoing named specailists not being versed in boilermaking in all its branches are not in a position to advise as are all-around boiler makers with a technical education.

The repairing of a boiler is really an independent branch of boiler construction; it is re-construction. Boiler repairing could be more cheaply and better done if those making the repairs had knowledge of the forces acting upon the boiler, as well as the knowledge acquired by the operating engineer from constant observation of the boiler while in service, and especially the practicability of a patch or new member as applied.

Thus, the operating engineer acquires certain knowledge hardly obtainable by experience by the boiler maker, who, by the very nature of his work, does not have the same opportunity of observation as the operating engineer. Also, the operating engineer is called upon to make certain emergency repairs, and under all these circumstances the more the operating engineer knows about the boiler, the better for him.

While it is not to be expected— or rather it should not be expected, that the operating engineer is to do the boiler repairing and the inspecting in additon to his many other duties, every engineer should be alert and give attention from time to time to discover any weakness or giving away of the boiler. Such attention would only be in harmony with the desire to secure maximum results from minimum expenditures, and to detect where possible any trouble or defect that might result in a boiler diasaster or shut-down.

Upon this basis this treatise will deal with many subjects in a manner of interest to the operating engineers; to acquaint them with the problems that confront the designer, as well as those who make and repair the boilers; and all with the hope and expectation that the work will be both interesting and beneficial to the operating engineers and others.

The Boiler Shell.

(3) The boiler designer in deciding upon the diameter of the boiler shell must bear in mind the working pressure

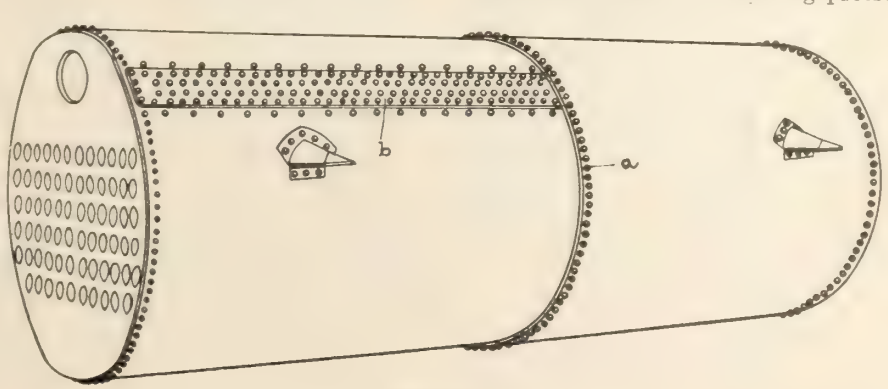

Fig. 3.—

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* First of a series of twelve articles on this subject.

per square inch, the factor of safety, the efficiency of the longitudinal seam, the tensile strength of the plates and their thickness, and the type of boiler. There are also practical considerations which he must take into account, and which will be mentioned later.

A boiler shell or cylinder has two forces tending to rupture it. The arrow A, Fig. 1, indicates the force acting on the transverse plane, or cross-wise of the vessel. The arrow B indicates the force acting on the lonitudinal plane, or lengthwise.

Though the steam pressure per square inch is the same throughout the boiler, the force acting on the transverse plane, generally called the girth plane, is about one-half the force acting on the longitudinal plane.

In Fig. 1, the vessel is shown seamless, and in order to explain fully the foregoing respective forces a concrete case of a seamless shell of 55,000 tensile strength, 66 inches in diameter by 14 feet in length, and of plate ½-inch in thickness will be given.

The force acting on the girth plane will be equal to the cross-sectional area multiplied by the working pressure per

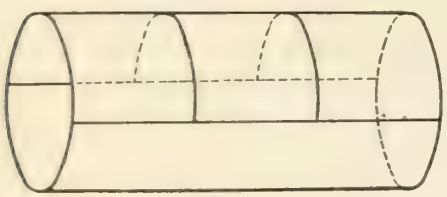


Fig. 4.—

square inch. With a working pressure of 100 pounds per square inch the total force will be:

66×66×.7854×100=342,100 pounds.

The force resisting the foregoing is the strength of the solid plate in the transverse plane. The area of the plate is found by multiplying the circumference by the neutral diameter, which is equal to the inside diameter, plus one thickness of plate, or 66 inches plus ½ inch, making 66½ inches.

Then the area of the plate of the girth plane upon which the force will act is:

66½×3.1416×½=78.2 square inches.

The strength or the resisting force of the plate of the girth plane will then be:

78.2×55,000=4,301,000 pounds.

The force acting on the longitudinal plane is equal to the area indicated by points 1, 2, 3 and 4, Fig. 1, times the working pressure in pounds. Since the vessel, Fig. 1, is 66 inches in diameter and 14 foot, or 168 inches in length and the working pressure is 100 pounds per square inch, the total force acting on the longitudinal plane will be:

66×168×100=1,108,800 pounds.

The resisting force of the plate of the longitudinal plane will be the length of the vessel from points 1 to 4, and points 2 to 3, Fig. 1, times the thickness of the wall. The length of the vessel having already been stated to be 168 inches between points

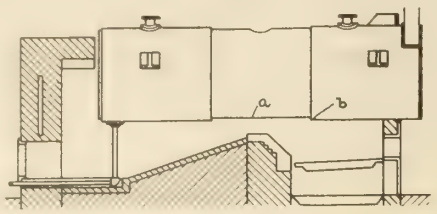


Fig. 5.—

1 to 4, the combined length from points 1 to 4, and points 2 to 3, is twice 168 inches, or 336 inches. The thickness of the wall of the vessel being ½-inch and the tensile strength of the plate being 55,000 pounds, then the resisting force is:

336 x ½ x 55,000 equals 6,930,000 lbs.

Since the longitudinal seamless plane has a resisting force of 6,930,000 pounds and the total force acting on said plane is 1,108,800 pounds, the ratio between the ultimate strength and the acting force is:

$$\frac{6{,}930{,}000}{1{,}108{,}800} \text{ equals } 6.25$$

The calculations in the foregoing paragraphs brought out that the force acting on the transverse plane amounted to 342,100 pounds, being resisted by a force of 4,301,000 pounds, therefore, the ratio between the ultimate strength and the working pressure is:

$$\frac{4{,}301{,}000}{342{,}100} \text{ equals } 12.5$$

Examination shows that the transverse load is approximately one-half the longitudinal load, and, accordingly the ratio between the ultimate strength and

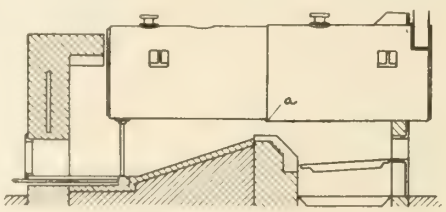


Fig. 6.—

the applied load on the transverse plane is about twice the ratio between the ultimate strength and the applied load on the longitudinal plane.

Longitudinal and Girth Seams

(4) Prominent among the many problems which arise in designing a steam boiler is that of the arrangement of the courses and riveted joints. Very few vessels are made seamless, and, accordingly the rings or courses composing the vessel must be connected together in some manner.

This is accomplished by the installation of rivet holes in the plates and then securing the plates to one another by over-lapping and riveting, or by butting the plates and securing them by butt or welt straps riveted to the ends of the plates.

In Fig. 2 is shown a course of a boiler as it would appear when rolled approximately into shape, and no holes installed for the seams. The calculations for a seamless course brought out that the vessel was twice as strong through the transverse plane as the longitudinal plane, and for this reason the designer can make the girth seam a, Fig. 3, single-riveted, while the longitudinal seam must be made double-riveted, or triple-riveted, and with a high-pressure boiler the longitudinal seam is made a triple-riveted butt double-strapped joint with the outer row of rivets in single shear, all as shown at the longitudinal seam b, Fig. 3.

The installation of the rivet holes does not make it possible to make the boiler at the longitudinal seam as strong at that point as the solid plate elsewhere in the longitudinal plane. The strength of the longitudinal joint will depend upon the type of riveted joint and the size and pitch of the rivets. The solid plate is to be considered as 100 per cent., and this is the case irrespective of the thickness of the plate, or its tensile strength.

Since the longitudinal seam is less than 100 per cent., and it is necessary when computing the working pressure to consider the strength or the efficiency of the longitudinal seam, the following formula, which is used by most authorities for ascertaining the allowable working pressure of a vessel, is given:

Where:

TS equals tensile strength of plate in pounds.
T equals thickness of plate in inches.
D equals diameter of boiler in inches.
F equals factor of safety.
A equals allowable working pressure per square inch.

$$\frac{TS \times T \times 2 \times E}{D \times F} \text{ equals } A$$

Factor of Safety

(5) It is not advisable to work a boiler or any other structure at or near its ultimate strength. There should be considerable difference between the ultimate strength and the allowable working pressure. The ratio between the two is called the factor of safety, and in boiler construction the minimum factor of safety allowed by most authorities is 4.

The factor of safety cannot be set in an off-hand manner; it must be decided by the circumstances of the case. Thus a boiler having all holes drilled in place

and constructed with a double-strapped butt joint, will—and justly so—be allowed a lower factor of safety than a boiler of like size and design, but with the holes punched.

Many of the authorities have established the minimum factor of safety at 4, and then add to it certain amounts in accordance with the type of riveted joint and the grade of workmanship. Such rules and regulations encourage good design and workmanship.

A high factor of safety does not indicate that the boiler is better constructed than a like boiler with a lower factor of safety. The minimum factor of safety should not be less than 4—and a boiler properly designed and constructed with a factor of safety of 4 is a safer boiler than one poorly designed and constructed with a factor of safety of 6.

The Hydrostatic Test.

(6) Merely because a steam boiler withstands a given hydrostatic or cold water test, it is no sign that the boiler is safe. The test itself, if improperly applied—that is, an excessive pressure applied, will injure the boiler. The elastic limit of the steel, which is about 50 per cent. of the ultimate strength of the plate, must be taken into consideration.

The elastic limit means the point where the applied load begins to produce a permanent elongation. Up to that point the metal will yield slightly, but when the load is removed the metal will return to its original length. It is never safe to place a load on any structure beyond this point. A boiler constructed for a working pressure of 100 pounds steam pressure per square inch, factor of safety of 5, would burst at approximately 500 pounds pressure per square inch, but the danger point would be reached at approximately 250 pounds (or the elastic limit) if the square of the section of plate in the longitudinal seam is equal to the shearing strength of the rivets.

This is assuming that the efficiency of the riveted joint is determined by the plate, maximum net section of plate, and the efficiency of the rivets exceeds the latter to some extent. With a factor of safety of 4, the boiler will show signs of distress at 200 pounds pressure, for as soon as the elastic limit of the plate is reached the plate begins to reduce in area, consequently a loss of strength ensues which cannot be regained.

It must not be assumed that a boiler constructed for 100 pounds pressure, factor of safety of 4, will be able to sustain a hydrostatic pressure of 200 pounds per square inch without serious and permanent injury to the plates. The hydrostatic test should at all times be less than the elastic limit, and a cold water test of one and one-half times the allowable steam working pressure is ample.

Number of Courses in a Boiler Shell.

(7) In the earlier days the designer was forced to give consideration to the size of plates obtainable. With the introduction of larger and heavier machinery in the rolling mills, plates are now made of greater thickness and length and width than formerly, and, accordingly the number of sections or courses now composing a steam boiler are fewer than before.

The steam pressure per square inch of steam boiler has increased gradually in late years, and this with the changes in the plates has caused the whole field of boiler designing and boiler constructing to undergo marked changes within the past fifteen years.

The number of courses to be used in a horizontal tubular boiler is a question upon which boiler designers are not all of the same opinion. Some have advocated making large tubular boilers of one course. This is the practice for the shells of small size tanks and air drums and like structures, and has given satisfactory results, but the one course large size boiler has been anything but a success, and for reasons which will be hereinafter given.

Others have advocated constructing horizontal tubular boilers with a long bottom course and several upper courses as shown in Fig. 4. There is no advantage in this form of construction in regards to the costs of manufacture. This plan of construction is used principally with large tanks, such as used by railroads for transporting oil. Vessels of this design have given satisfaction in the foregoing field, but what few boilers of this design, where the shell is in contact with the flames and hot gases, have been a source of trouble almost from the day they were installed.

The majority of boiler manufacturers are now constructing tubular boilers with either two or three courses. The tendency is to favor the two-course boiler. This is due to the fact that a two-course tubular boiler can be constructed somewhat cheaper than a three-course boiler. The boiler manufacturer in order to meet the demands for boilers at low figures, naturally, designs and constructs the type which has the lowest first costs.

While the purchaser desires to purchase everything as cheaply as possible, which fact has been deeply impressed upon the mind of the manufacturers, the purchaser should take into consideration the whole field and not merely first costs.

The three-course tubular boiler as shown in Fig. 5, is favored as the girth seams a and b stiffen the shell sheet, while the stiffening of a two-course boiler as shown in Fig. 6, is only one-half that of the three-course boiler. Of the above respective types of boilers, experience has shown that a two-course boiler with long longitudinal seams is not as satisfactory as a three-course boiler with short longitudinal seam, and as a general rule a three course boiler is more durable than a two-course boiler.

There is also another point in favor of the three-course boiler. The girth seam of a three-course boiler is well away from the bridge wall, the same being indicated in Fig. 5, while the girth seam of a two-course boiler is directly over the bridge wall, the same being indicated in Fig. 6. With a three-course boiler the impinging flame strikes the shell sheet at about the point a, Fig. 5, while with a two-course boiler the impinging flame strikes the shell sheet at or near the girth seam a, Fig. 6.

While it is true that the girth seam b of a three-course boiler is directly over the furnace—and this is not the case with a two-course boiler—the girth seam b, Fig. 5, does not come in contact with the impinging flame as does the girth seam a, Fig. 6.

The foregoing considerations are uppermost in the minds of boiler designers when designing tubular boilers. In addition thereto comes the question of repairs. It has been found that a two-course boiler is more liable to bag from scale, mud and grease than a three-course boiler, and further when trouble of this character arises, a three-course boiler tends to prevent the bag from spreading over a great distance, and accordingly the repairing is usually less with a three-course boiler than a two-course boiler.

Sidney Electric Power Co.

The Jens Oaten-Boring Co., Toronto, are supplying the turbines for the power plant of the Sidney Electric Co., near Trenton. The generating apparatus being installed consists of four 750 k.w. vertical type units, 60 cycles, 3 phase, 6,600 volts. These with two exciters are being supplied by Messrs. Kilmer, Pullen & Burnham, Toronto, Canadian agents for the General Electric Company of Sweden. Current will be stepped up to 44,000 volts for transmission along the lines of the Seymour Power & Electric Co. to Oshawa, Bowmanville, Cobourg, Brighton, Colborne, Trenton, Belleville, Lehigh Portland Cement mill and other substations along the lake front. The step-up transforming station will contain, at present, three 3,000 k.v.a., 3 phase water cooled transformers, to be furnished by the Canadian Westinghouse Co., Hamilton. For stepping down the voltage in the various sub-stations, thirteen 750 k.v.a., 3 phase, and other smaller sized transfarmers have been supplied by the Canadian General Electric Co., Toronto. Smith, Kerry & Chace are the engineers in charge of developments.

NELSON DANGER SIGNS.

The "DANGER ! HANDS OFF !" on Nelson's red danger signs should assist in avoiding accidents in power plants where they are used. Engines have been wrecked because the assistant opened the throttle when he didn't know the throttle was temporarily out of order. Machines have been seriously damaged because a switch was thrown when they were undergoing repairs.

The idea of this sign was suggested by an accident in a boiler room, that fatally scalded the fireman, which accident

Nelson's Danger Sign.

would have been avoided if a sign similar to the one in the illustration but printed in red, had been tied to the valve which was opened by an assistant who "didn't know."

To avoid these accidents the Nelson Valve Co., Philadelphia, will furnish these red danger signs free to all men who can use the signs, to protect life and property.

COST OF POWER IN CALGARY.

Calgary spent $110,222.49 for power in 1910. At station No. 1 a staff of twenty-four men are employed :—One power house foreman, three engineers, two fitters, two oiler wipers, two switchboard operators, ten firemen, three trimmers, one boiler washer. No. 2 plant will be ready to operate Feb. 1. The average production of power in 1910 was 2,400 horse power. The plants are in charge of Supt. J. F. McColl.

Current generated during the year :

	k.w. hrs.
Alternating current	2,850,000
Direct current	1,637,400
Total	4,487,400

The cost of generating this current is itemized as follows :

Maintenance of boilers	$ 2,823.25
Maintenance of street railway machine	801.17
Maintenance of light and power machines	1,515.39
Oil and waste	3,912.76
Sundries	900.64
Water	6,166.00
Salaries	20,407.97
Sundry	415.65
Fuel	50,375.86
Depreciation (5 per cent.)	16,802.95
Sinking fund and interest	6,078.89
Total	$110,222.49

STANDARD COLORS FOR STATION PIPING.*

By J. P. Sparrow.

The increase in size and the complexity of the equipment of our modern power plants has naturally resulted in complication of the piping systems. It has been made evident that some means of identifying and readily tracing the piping for superheated and saturated piping and direction of flow of the contained fluids is both convenient and necessary for the operating engineer.

In our smaller stations of earlier design we had steam, water, oil and air piping, usually a common system for all units. In our present stations we have steam water piping for house service, boiler feed, jackets, cooling coils, ash sprinkling and fire service, both salt and fresh; oil piping, both gravity and high pressure, and of different qualities for different service. We have air piping for pneumatic tools, blowing boilers and general pressure service.

Piping systems are usually designed on the common or the unit basis, with the latter often interconnected. Where space is limited, the piping systems of a large power station become very much complicated and involved, making the tracing of the individual lines a matter of difficulty.

This condition has led to the very general adoption of some scheme of tagging, lettering or coloring the different piping systems to make easier their identification or to indicate their use. Many of these schemes have been based on the practice of the United States navy, where, on board ship, the most complicated systems are found.

Correspondence with prominent designing and operating engineers resulted in agreement without exception as to the need of proper means of identification; the question has been submitted to the American Society of Mechanical Engineers with recommendation for action and adoption of a color scheme which may be accepted as standard.

At present there is wide variation in the system adopted, schemes having been evolved on the one hand with a view to durability or coloring, and on the other, that the color be suggestive of the use.

The requisites of a color scheme for identification purposes are, in the writer's opinion:

That colors should be permanent.

That tints should be avoided, primary colors being used as far as possible.

That where variation in use occurs the distinction should be made in variation of band, fitting or flange coloring, retaining the body color as distinctive of the class.

That the piping receiving the highest temperature should be the darker colors.

Coloring of piping is not all that is necessary to make easy the quick handling of a system in time of trouble. Stenciling at frequent intervals (30 to 50 feet) showing the use of the line and arrows showing the direction of flow have been found to be of great assistance at times of emergency, and also of great help when construction work is being carried on during regular station operation; the opening or closing of a valve by mistake may mean serious interruption of service; proper means of identification make such mistakes almost imposible.

* Paper presented before the Association of Edison Illuminating Companies.

EXHAUST TURBINES IN CANADA.

The first exhaust steam turbine in Canada has been set to work at the Dominion Coal Company's No. 2 colliery in Nova Scotia. It is a 1,400 h.p. set by Daniel Adamson & Co., and furnishes electric power to the coal company's plant, from steam which previously ran to waste. Other exhaust steam plant, consisting of two 680 h.p. low pressure turbines, is being erected for the Nova Scotia Steel and Coal Co. The steam for this plant comes from the rolling mills. Two more Adamson sets of 3,000 h.p. capacity and of the mixed pressure type, are being shipped to Canada by Daniel Adamson Co.

SMOKE NUISANCE.

Smoke nuisance is due to numerous causes. The smoke inspector of Milwaukee says, that very frequently the increase in capacity in manufacturing plants, has not been accompanied by a corresponding increase in their boiler capacity, and in order to obtain the required duty, furnaces are forced to such an extent, as to make it impossible even for the men in charge, to comply with the ordinance. Lack of room for more or larger boilers in such plants, is often due to faulty architectural designs, and we also find them placed in more or less inaccessible positions, instead of roomy, well ventilated quarters ; so that the firemen spend as little time as possible in the boiler room, and hasten out to get fresh air to cool themselves. On the other hand, if architects would look more to the comfort of the men, it would induce them to spend more time in the boiler room, and better results in economy would be obtained.

Fig. 1.—General View of Allan Gardens Palm House, Toronto.

Dunham Trap Installation at the Allan Gardens, Toronto

The Purpose of the Dunham System is Two-Fold: To Withdraw the Water and Air From Pipes and Radiators at Discharge End and Prevent the Escape of Live Steam Through the Discharge Pipes.

A typical installation of the Dunham Vacu-Vapor System has been made in the Allan Gardens Conservatory, Toronto, a general view of which is shown in Fig. 1. In the conservatory are 3,200 sq. ft. of heating surface. The radiators are arranged around the base of the building with coils around the domes to keep the gutters from freezing.

Each radiator is equipped with a Dunham trap. The pressure in the radiators is ½ lb. To obtain this pressure a Fisher pressure reducing valve is employed. The valve connected to radiator is shown in Fig. 2, while a full size valve is shown in Fig. 3.

The Dunham radiator trap is made of brass and phosphor bronze. In the base of the trap body is a three-eighths inch valve opening. In the cap is securely anchored a hollow, corrugated disc, which contains a combination of fluids. These fluids are practically non-corrosive, and, being contained within an absolutely air-tight space, will last indefinitely. Hot water and air have no effect upon the disc containing these fluids, but contact of the disc with steam causes immediate vaporization of the fluids. The vaporization of the fluids converts the contents of the disc into gas, which exerts a pressure of 25 pounds upon the inner walls of the disc. This pressure closes the valve and traps the steam. Upon the lower side of the disc is a flat valve which is ground to fit the valve seat in base of the trap body. When the expanded disc presses the valve down onto this seat, a perfectly steam-tight joint is formed

Air and water pass through the trap very rapidly, but the instant steam enters the trap, the fluids change to gas and expand the walls of the disc, which presses the valve down against the ground seat, closing the trap. When condensation or air again forms in the radiator and flows into the trap, the gas in the disc immediately condenses to a fluid and contracts the walls of the disc, which opens the valve, allowing the condensation and air to pass out.

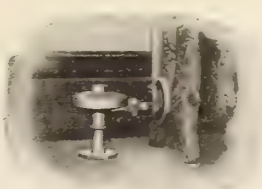


Fig. 2.—Dunham Trap Attached to Radiator.

The trap complete, with radiator connection, weighs forty ounces; measures four inches from end to center and is made in four styles, viz.: angle, right-hand, left-hand, and straight-way pattern. Half and one-inch offsets are furnished to conform with measurements, where the piping is already installed.

Power House Equipment.

The layout of the power house is shown in Fig. 4. The boiler room is 37 x 43 ft. and contains two 46 h.p. boilers built by the John Inglis Co., Toronto. Provision is made in the size of the boiler house for the addition of more boilers if necessary. At the present time only one boiler is in use, the second one being installed with the idea of taking care of immediate contemplated additions to the palm house. In case of repair, also, one boiler may be shut down for repairs, the other being of sufficient capacity to carry the load.

The two boilers are equipped with "Cyclone" Grate Bars manufactured by the Canadian Steam Boiler Equipment Co., 186 Queen St. East, Toronto.

In the line drawing Fig. 4, A is the Fisher reducing valve, B is a by-pass, C an oil separator for pump exhaust, D the Fisher governor and E the discharge to sewer.

Views of the pumps are shown in Figs. 5 and 6. There are two 4½ x 6 x 7 Martin vacuum pumps shown in the background of Fig. 5 and the foreground of Fig. 6. In the foreground of Fig. 5 is shown the 4½ x 3 x 4 Martin automatic steam pump and receiver, the three pumps being made by the Martin Pump & Machine Co., Toronto. Only one vacuum pump is used at the present time, either one being of sufficient capacity to give the required vacuum.

Steam Circulation.

The steam pressure in the boiler is maintained at 25 lbs. This is reduced to ½ lb. by a Fisher pressure reducing valve at which pressure it reaches the Dunham radiator traps.

All piping between the boiler house and the conservatory is laid through a 6 x 6 ft. tunnel which connects the power house and conservatory.

The Dunham traps are arranged on the

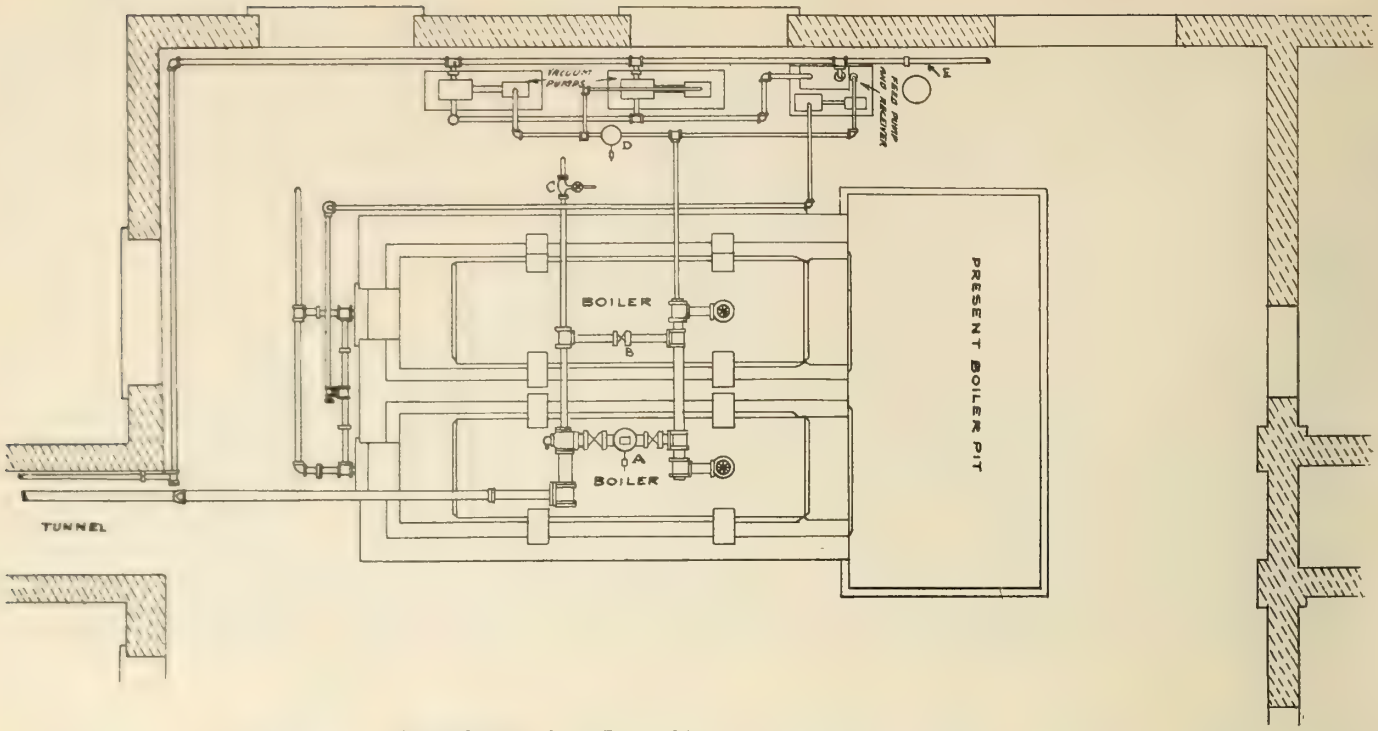


Fig. 4.—Layout of the Power Plant at Allan Gardens, Toronto.

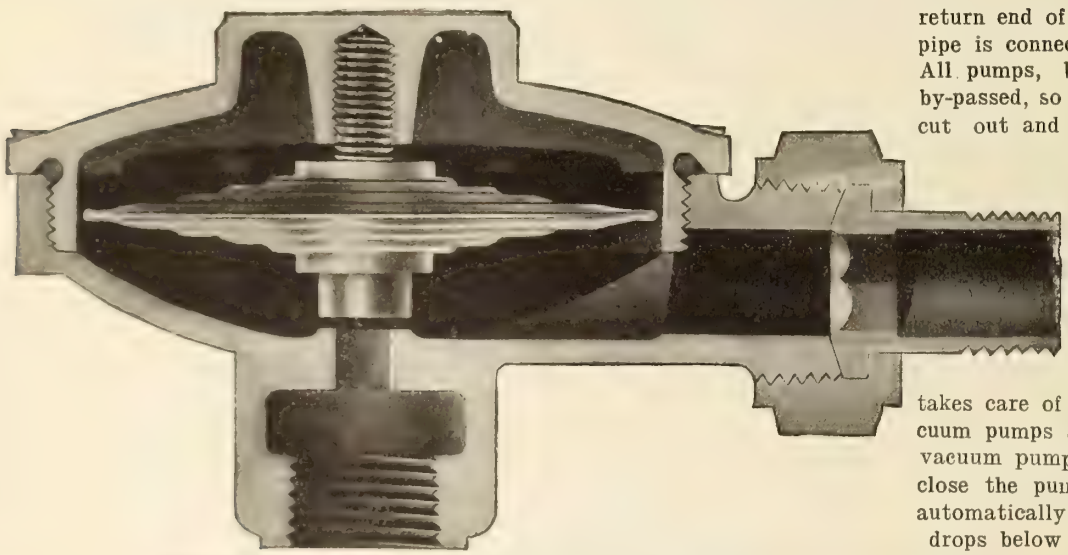


Fig. 3.—Construction of Dunham Trap, made by C. A. Dunham, Toronto

return end of each radiator. The return pipe is connected to the vacuum pumps. All pumps, both steam and water, are by-passed, so either vacuum pump may be cut out and repaired while the other takes care of the condensation. The vacuum pumps are controlled by a Fisher vacuum pump governor which is set to close the pump at 10 ins. vacuum and automatically opens when the vacuum drops below that.

Fig. 5.—The Pumps at Allan Gardens, Showing the Boiler Feed Pump in the Foreground.

Fig. 6.—The two Vacuum Pumps in the Foreground.

The vacuum pump draws the condensation from the radiators and pipe line and discharges it into the receiver of boiler feed pump which is vented to air. The boiler feed pump feeds the condensation to the boiler again.

An oil separator on pump exhaust was made by the Smart-Turner Machine Co., Hamilton, forms part of the equipment. The radiators were supplied by the Gurney Foundry, Toronto. The pipe coverings were supplied by the Eureka Mineral Wool & Asbestos Co. The steam traps, Fisher reducing valve and Fisher pump governor were supplied by the C. A. Dunham Co., 511 Continental Life Bldg., Toronto. The installation gives a very even temperature, 65 to 70 degrees being constantly, maintained.

Power Plant Troubles, Happenings and Improvements

By A. E. B.

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

BOILER EXPLOSIONS AND LAP JOINTED LONGITUDINAL SEAMS.

Recent boiler explosions in the United States, with shocking results to life, limb and property, have by their succession and frequency, called forth the trite remark, "that the barbarities of peace are greater than those of war."

Whether the statement is completely justified or not, the fact remains, that in no other country, save the United States, does the barbarism of longitudinal lap joint construction exist, nor is its disastrous effects more exemplified.

"Power and the Engineer" hits out straight from the shoulder on this subject, and it seems to us opportune, not only to support it in its crusade, but to set forth the duty of Canadians in respect to the evil.

No soft impeachment is made by "Power" when it says "it is a matter of common as well as shameful knowledge, that license in the design, construction and operation of admittedly dangerous boilers, obtains in the United States, which is tolerated in no other part of the civilized world."

The Cause of Ultimate Failure.

The outstanding feature of weakness in the lap joint is the treatment that the steel receives in the offsetting process necessary to this construction. Steel of high carbon, high tensile strength, and hard, is subjected to the same amount of slogging that a soft ductile material might be supposed to stand. This initial punishment it undergoes, lays the foundation for aggravation, when the completed boiler in service carries with it the uncircular offset of its shell plate joint.

The cost of a lap joint, and a double butt strap joint in comparison, does not in our opinion favor the former so much as to make it so universal of adoption by boilermakers.

The statement that 80 per cent. of the boilers in use in the United States, are of lap joint construction, is such as to stagger the average engineer, and raises the interesting query in one's mind, what is the reason? There undoubtedly is one.

Limit of Life.

The suggestion to limit the life of this type boiler to 10 years seems a good one; its only objection being, in our opinion, that seven years would be more effective. Ten years is a fair length of time to subject a boiler to hard work and harsh treatment (many of them get it) besides, it would tend more than anything, towards the elimination of the lap joint from boiler shells, if seven years were made the limit.

The longitudinal shell joint is, in a new well designed and constructed boiler, the weakest part of the shell, irrespective of its being lap or double butt strap. Being this to begin with, it is not intentional, and far less desirable, that it continue so. Parts of the shell away from the joint, deteriorate and depreciate, yet most often where the defect can be seen. When this does take place, we have a right to assume that the joint may not then be the weakest point, and our assumption should be a matter of fact.

With a lap joint, it seems as though the proportional initial inequality of strength should be maintained to that of the depreciated part of plate, thereby making provision for a joint deterioration, that is at all times hard to determine, but as surely existent.

The subject is a pressing one, calling for rigid boiler laws, and is of personal interest to all who own, use or operate steam boilers.

GREASE IN STEAM BOILERS.

The opinion has been expressed by a well known engineer that the real cause of trouble, when grease or oil adheres to the water surface of a boiler plate, lies in the fact that the water is not in actual contact with the plate surface, but is isolated or insulated by the greasy layer, which prevents the metallic surface being wetted, and allows overheating to take place irrespective of plate thickness.

No matter how thick or how thin this greasy layer may be, its effect will always be the same, so long as it prevents water contact with the plate.

Scale as distinct from grease, is liable to have a similar tendency, but of a rather more conditional kind. If the scale thickness is compact, and adheres close to the plate, forming as it were an increased plate thickness, to which the water has access, no corresponding ill effects are liable to follow in an equal degree, a conclusion which is borne out by general experience.

Furnaces have been overheated, due to grease ⅛-inch thick on their surface, while those with twice that thickness of scale, gave no trouble; lending color to the theory which has been often advanced, that plate thickness, so long as water contact is assured, is not as all-contributory, even when increased beyond prevailing practice, as one would infer.

It is again a matter of common knowledge that a thin, closely adherent scale protects against pitting, without in any way militating adversely as regards steaming.

Grease and scale affect all steam boilers to a lesser or greater extent in regard to both safety and economy, and while one may be somewhat more undesirable than the other, neither are to be courted by the man who is alive to the importance, of being called a careful and resourceful engineer.

This means of "easy money" is uncomplimentary to giver and receiver alike. It is a slur on competency, an expensive way of evading the truth about one's boiler, and a courting of disaster.

Boiler Insurance.

The question of boiler insurance does not apply to our subject, except in so far as a protection against unforeseen circumstances is concerned. We insure our lives, because death is certain, although the time be uncertain.

That a boiler will blow up, is not at all certain, and as a matter of fact, very few, comparatively speaking, do blow-up. Competent inspection, care in operation, and efficient supervision all contribute to the explosion famine.

The Competent Inspector.

To those who are called upon to exercise the responsibility of inspecting and certifying a steam boiler, we would say, do your duty fearlessly and well, not only with respect to the boiler and its owner, but also to yourself; and charge a substantial professional fee. If you don't have the confidence in your ability to earn that fee, then cut-out boiler inspection from your stock-in-trade.

It seems as though no better test of a man's qualifications for this work is so easy of application by the man himself, or the person requiring his services, and so effective in securing the best results.

TURBO BOILER FEED PUMPS.

The turbo pump has entered the field hitherto held and claimed by the direct acting steam pump, with regard to boiler feed. Its adoption has, it is true, been limited to power plants of large size; nevertheless in the near future, we should not be surprised to find its many advantages, a warrant of installation by those having small and moderate sized equipments in project.

A few of the advantages possessed by turbo pumps, over those of the direct acting steam type, are its greater simplicity of detail of construction, ensuring greater certainty of operation; its freedom from shocks and vibration, endangering pipe lines; its non-requirement of heavy foundations, its higher efficiency, its simpler regulation, its lower first cost and maintenance charges, and its smaller space occupied.

The requirements of a power plant generally are sought for along the foregoing lines, and the vital requirement of boiler feed calls for that apparatus, which will best fulfill its many exacting considerations.

BOILER INSPECTION.

The inspection and certification of a steam boiler are in a class by themselves, as far as fitness on the part of engineers is concerned. A man competent, should have a good education, a will of his own, and know how and when to exercise it. He should be thoroughly conversant with the design, details of construction and operation of all types of boilers—One is so apt to forget that there are other boilers in service, besides the return tubular type set in brickwork. He should be a keen reader of men, and appreciate the failings of operators as well as boilers; taking nothing for granted from either. His character should be above suspicion and his declaration signature a guarantee of public security.

Such a man may act in a private capacity, or be in the employ of a Boiler Insurance Company. In either case, he is worthy of substantial remuneration for his services.

Qualified Inspection—Immunity from Accident.

Withal, accidents and explosions are liable to occur, because in this, as in other spheres, perfection is not yet attainable, through even the fittest human instrumentality, and absolute immunity from disaster, no boiler inspector may guarantee.

The practice of calling in the "man off the street," as it were, to have a look at your boiler and have him say for a miserable two to five dollar pittance, that "it is in as good order as the day it went in," without as much as looking at anything save some cracks in the brickwork, is we hope dying out.

A Number of Interesting Applications of the Dart Union

Since Companies Have Specified in the Manufacture of Unions, Many Improvements Have Been Made, Besides Adapting Them to an Increasing Number of Uses—New Patterns Have Been Made Recently Combining Unions and Pipe Fittings, These Overcoming Many Annoyances and Difficulties That Confront an Engineer When Installing Steam Piping.

THE use of unions in steam pipe work has become a permanent factor in engineering practice. In connecting up a piece of work, a union simplifies the job, eliminating the many difficulties that had to be overcome. An engineer often had to connect up pipes of different diameters, and to do this, reducing nipples, etc., had to be used. The result was the waste of a great deal of time pipe threading, making right and left threads to connect up the pipes. Sometimes it meant capping the pipe and drilling and tapping a hole the size of the smaller pipe. It thus caused considerable loss of time.

The Dart Union Co., Toronto, have placed on the market a new line of

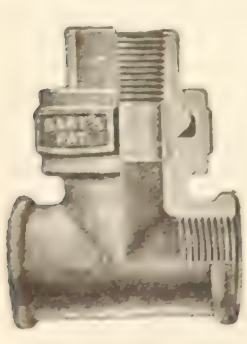


Fig. 1.

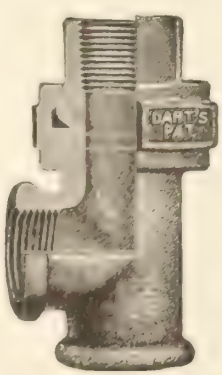


Fig. 2.

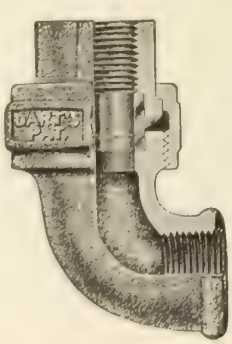


Fig. 3.

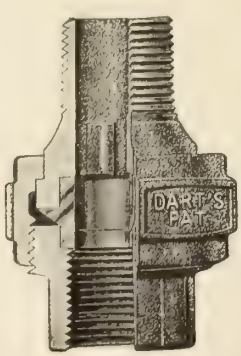


Fig. 4.

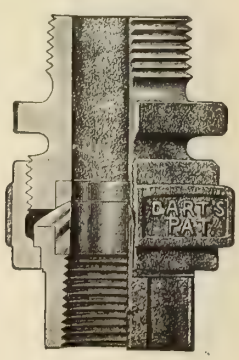


Fig. 5.

unions which overcome many difficulties and much trouble and annoyance. These are illustrated in the five accompanying illustrations :

Fig. 1 is a Tee with union on the outlet.

Fig. 2 is a Tee with union on the run.

Fig. 3 is an elbow union.

Fig. 4 is a male and female coupling.

These four are made in eight sizes from ¼ in. to 2 ins.

Fig. 5 is a reducing union made in four sizes, 1 to ¾ in. ; 1¼ to 1 in. ; 1½ to 1¼ in. ; and 2 to 1½ in

Dart Union

The unions on the combination fittings are standard Dart unions having two bronze seats making a bronze to bronze joint. The bronze seats are forced into the recesses bored and faced to receive them. The ball shaped ground seats make an excellent joint. These joints do not corrode and may be used for steam, water, gas, oil or air. The body of the union is malleable. They are made with strong nuts, substantial shoulders and in heavy patterns and are designed to stand a steam pressure of 250 lbs. and a hydraulic pressure of 1,500 lbs.

Application.

As will be seen in the illustrations, the unions are combined with pipe fittings. Any combination may be had as desired. Five adaptations are here shown but they are made with the union at any opening of the fitting and the coupling may be male or female as desired.

The advantage of such combinations is evident. If an engineer desires to connect up a pipe in a corner where there is little room, Fig. 3 offers a solution to the problem. In fact any desired piping may be made and connected up within the limit of sizes given above.

Series of Practical Questions and Answers for Engineers

By A. E. B.

Every Care is Being Taken to Include Only Pertinent Practical Questions, and Give Same, Direct Reliable Answers. Catch Questions will be Avoided. The Knowledge of Simple Addition, Subtraction, Multiplication and Division of Decimals, Will be Found a Most Useful Companion Study, and Should Not be Overlooked.

1—Q Explain the expressions "saturated," and "superheated," as applied to steam?

A Saturated steam is moist, and has a temperature corresponding to that of the water from which it has been evaporated, and to its pressure, Superheated steam is saturated steam dried, and raised in temperature, in a vessel distinct and separate from that containing the water of evaporation. Its temperature is always more or less in excess, of that corresponding to its pressure.

2—Q To what strain is the shell of a steam boiler subject?

A To a tensile or tearing apart strain in the girth direction of the plate. For this reason we use the ultimate tensile strength of the material, in calculating the working pressure permissible.

3—Q If you were specifying the steel for boiler shell plates, what qualification would you make in respect to thickness and quality ?

A That each be uniform, providing equal wear and strength throughout.

4—Q Is the shell of a boiler equally strong longitudinally and circumferentially?

A No, it is twice as strong in the latter direction as it is in the former.

5—Q In a new, well designed, well constructed boiler, where is the shell weakest?

A Along the riveted joint, due to the rivet holes.

6—Q Why is a butt joint preferable to a lap joint in a steam boiler?

A Because it avoids offsetting the plate ends, keeps the shell in a true circle, and gives a stronger joint.

7—Q What is the objection to welding the longitudinal joints of a boiler shell?

A No guarantee can be had of the reliability of a weld. The pressure being internal and bursting, would tend to aggravate any imperfection, and open the weld, causing an explosion.

8—Q What is the difference between a tube and a pipe ?

A A tube is indicative of surface, a pipe of area. Example: a 3-inch tube will measure 3-inch outside diam., while a 3-inch pipe will measure 3-inch inside diam.

9—Q Are two 4-inch pipes equal in erea to one 8-inch pipe?

No. The 8-inch pipe has an area double that of two 4-inch pipes. Doubling the diam, therefore, increases the area fourfold.

10—Q When are small smoke tubes 1¼ and 1½ inch diam. used in boilers?

A Under forced draft conditions, on account of the rapidity with which the gases pass through the tubes, and the necessity of their being in contact with the tube surface all the time. With ordinary natural draft-sized tubes, the gases would simply take a central course with little or no surface contact.

11—Q What is lead?

A Lead is the amount of steam port opening at the commencement of each piston stroke.

12—Q What is lap?

A Lap is the amount the valve covers the ports at each end of the valve face, when it is in middle position.

13—Q Should a valve in its travel open a full port to live steam?

A No. Because the ports are designed, so as to allow of a free escape of exhaust steam, and if a full port is given, or is necessary for live steam. then for exhaust, the port is not large enough.

14—Q Why is it necessary to have a larger area of port for the exhaust, as compared with the live steam?

A Because the live steam having done its work in the cylinder has fallen in pressure, and become naturally of greater volume, and requires a larger space or area for escape.

15—Q What is Boyle's Law ?

A Boyle's Law defines a perfect gas as having a constant pressure volume.

$$pv = \text{constant.}$$

Example—Steam at 100 pounds pressure in a vessel of 10 cubic feet capacity.

$$100 \times 10 = 1000$$

If we pass that steam into another vessel which is 20 cubic feet capacity, the pressure will fall to 50 pounds, thus:

$$\frac{1{,}000}{20} = 50 \text{ pounds}$$

showing that the constant value remains the same. It is this volume increase, that calls for ports and exhaust pipes being larger in area than live steam admission openings, and live steam pipes; the pressure being lower.

16—Q What is piston speed, and how is it expressed ?

A Piston speed is the distance in feet the piston actually travels in one minute. It is usually expressed as piston speed in feet per minute.

17—Q The solid plate is reckoned as being 100 per cent. What are the comparative percentages that can be got by using single, double and treble riveted lap joints, double and treble riveted butt strap joints?

A Single riveted lap, 56 per cent.; double riveted lap, 70 per cent.; treble riveted lap, 75 per cent.; double riveted double butt strap, 80 per cent.; treble riveted double butt strap, 85 per cent.

18—Q In a double butt strap joint, the outer butt strap is usually made narrower than the inner. Give the reason why?

A It assures a good caulking edge on the outer strap, free from liability to "spring" between the rivets, which are close pitched.

19—Q From what part of the joint do we reckon the strength of plate left between rivet holes, in a treble riveted double butt strap joint?

A From between rivet holes on the outer and widest pitch longitudinally.

20—Q What is meant by single and double shear, as applied to rivets?

A Single shear means that the rivet has only got to cut or shear through once before the joint gives out. Double shear means that the rivet has got to cut or shear through twice before the joint gives out.

21—Q Give an example of single shear rivets and double shear rivets.

A The rivets in a lap joint are in a single shear. Those in a double butt strap joint are in double shear, in all cases of their passing through both butt straps. Where the outer butt strap is narrower than the inner, the outer row of rivets is in single shear, because they pass through the shell and inner strap only.

22—Q In a slide valve engine, how is the steam usually admitted to the cylinder?

A Over the ends of the valve.

23—Q In a piston valve engine how is the steam generally admitted to the cylinder?

A Over the ends of the valve, or in the centre of the valve.

24—Q With the slide valve, where does the exhaust get out?

A At the centre of the valve.

25—Q With the piston valve, where does the exhaust get out?

A At the centre or over the ends of the valve, depending on how admission is made.

26—Q What is the relation of the eccentric to that of the crank on a slide valve engine?

A 90 degrees plus the lap and lead, in advance of the crank.

27—Q What is the relation of the eccentric to that of the crank on a piston valve engine?

A If steam is admitted over the ends of the valve it is 90 degrees plus the lap and lead in advance of the crank. If steam is admitted at the centre of the valve, it is 90 degrees less the lap and lead, behind the crank.

Explanation of Principles Involved in Answers to Questions

By A. E. B.

The Holding up of Oneself with the Memorizing of a Series of "Don'ts," With Bold Knowledge Given of What You Should do, and the Cramming of Your Head with "Kinks," Will be of Little Service in Enabling You to "Hold Down" a Position, if You Have Neglected to Add Intelligence to Your Knowledge. Many a Child Can Repeat the Alphabet, but Cannot Distinguish One Letter From Another. In This Series We Aim to Help You.

ENGINES

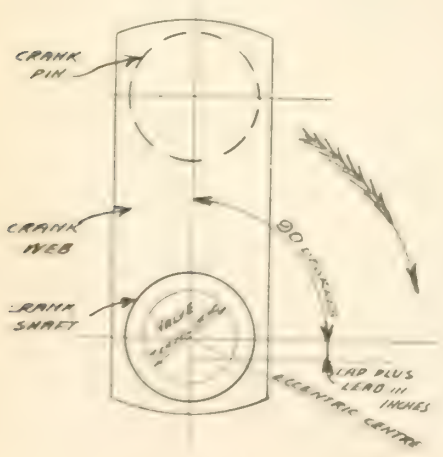
Relation of Eccentric and Crank.

Figs. 1 and 6 represent the proper relation of crank and eccentric, when a steam engine, and the steam admission is over the ends of the valve.

Figs. 2 and 7 represent the proper relation of crank and eccentric, when a slide valve or piston valve is used on a piston valve is used, with steam admission at centre.

In the first case, Q 26, the eccentric is set in advance of the crank, while in the second case Q 27 (latter part of answer) the eccentric is set behind crank, and in an exactly opposite position to the other.

This, of course, is as it should be, the admission being at the opposite edge of the port, and the valve movement being also in the opposite direction to attain it.



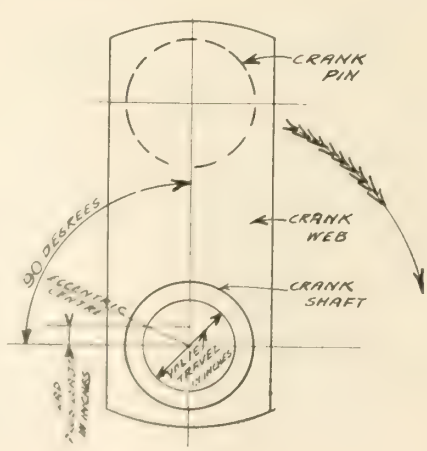


Fig. 2.

BOILERS.

It is not always the strength or weakness of the boiler that measures the danger of an explosion. The weakness of human beings must also be considered.

Strain on Boiler Shell.

Fig. 3 illustrates how the pressure acts on a cylindrical boiler shell, and

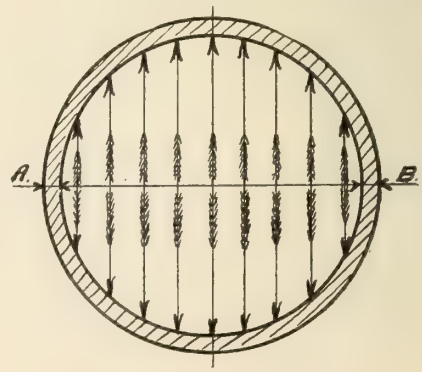


Fig. 3.

shows that its effect is at right angles to any diametrical line, or line through the centre. It creates a pulling or tensile strain on each half diameter, in opposite directions, as indicated by the arrows, and makes clear, that to keep each half from blowing apart, the two thicknesses of plate at A and B must be sufficient.

Rivets in Single and Double Shear.

Referring to questions 20 and 21, Fig. 4 is a single riveted lap, showing the rivet in single shear. It is obvious that if the rivet is cut through on the line a.a., the means of fastening the two plates is gone. The same results will

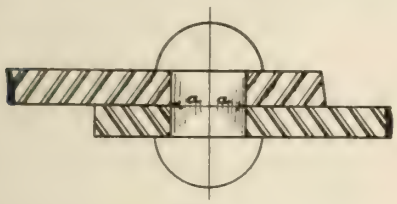


Fig. 4.

be apparent with rivet 3 on Fig. 5, butt strap joint.

Rivets 1 and 2, however, on Fig. 5 double butt strap joint are in double shear, necessitating a cutting through of each of these two rivets at a.a. and b.b., before the joint would be altogether gone. Of course if shearing took

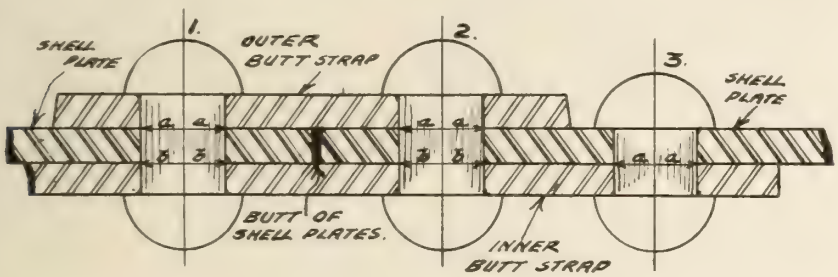


Fig. 5.

place at a.a. or b.b., the usefulness of the boiler would be at an end for the time being at least, although only one section was gone.

The point, however, is, that theoretically and intentionally the rivet being of uniform diameter and quality, shear or rupture must take place in the two places at the one time. To cover inequalities of riveting and of strain carried, the best practice rates double shear rivets at one and three-quarter times that of single.

Rivet Holes.

These are drilled, punched and reamed 1-16 inch larger in diameter than the cold rivet, to provide for the rivets being somewhat unshapely, and to allow for their expansion when heated. The mouths of the holes should have a slight countersink.

Shell Manhole.

The longer axis of this should always lie girthwise on a boiler, because thereby, less plate section is cut out longitudinally. This provision is, of course, necessary on account of the comparative weakness in that direction.

Some May Not Know.

Under this head, in our December issue, "Why is the return tubular boiler,

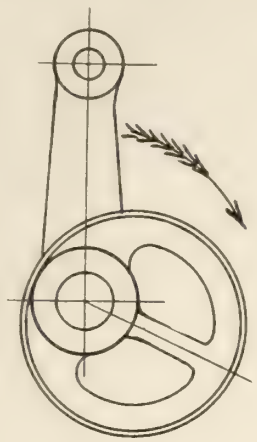


Fig. 6.

with which we are all so familiar, usually limited as a maximum, to 7 feet diameter," and "why are the girth seams in all boilers as a rule only single riveted," were questions given our readers to answer.

The "why" of the first question, is because increase of diameter beyond 7 feet, with the pressures now prevailing, would necessitate a shell plate thickness in excess of what would be safe against burning and collapse. It has to be borne in mind that the fiercest heat of the furnace is in direct contact with the lower shell plate, where also, irrespective of plate thickness, all sediment

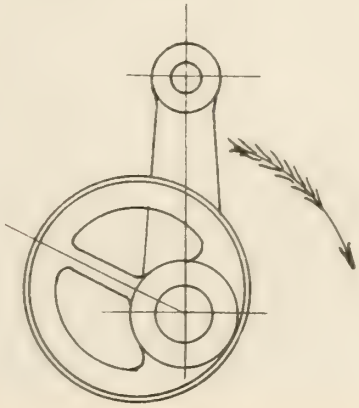


Fig. 7.

is bound to lodge, being a further aggravation, and means of keeping the water and fire surfaces of the plates too far apart.

The "why" of the second question is because the boiler is twice as strong in the girth direction as it is longitudinally. With a single riveted joint on the former, we get a comparative strength of joint with the solid plate, of 56 per cent., while with the latter, only 85 per cent. can be got with a triple riveted double butt strap joint.

Comparing these two percentages shows the longitudinal seam not to be twice as much as the girth seam, which it should be for equal rating, hence the sufficiency of singe riveting for the latter.

LIGNITE FOR POWER PLANT BOILERS.

Bulletin 2 of the Bureau of Mines is a pamphlet of 42 pages by D. T. Randall and Henry Kreisinger, dealing with "North Dakota Lignite as a Fuel for Power Plant Boilers." The tests described were made at the power plant of the United States Reclamation Service at Williston, N. Dak. The boiler furnaces were designed to burn a brown lignite mined on adjacent Government land. The furnaces were of the semigas produce type, having an external resemblance to a Dutch oven. The grate was 21 in. below the lower edge of the firing door, and the space between the bridge wall and the end of the prolonged firebrick arch was contracted. This construction permitted of a thick fuel bed and at the same time enabled the fireman to see its condition at the top. The conclusions of the authors are thus stated :

The combination of boiler and furnace setting described gives good results with the North Dakota lignite. Steam can be made with a fuel efficiency of 55 to 58 per cent. of the heat in the coal, and no difficulty is experienced in obtaining the full capacity of the boiler.

These results compare very favorably with the results obtained in the average plant using a good grade of bitumious coal when the heat available to the boiler is considered.

Little, if any, advantage is gained by crushing the coal by hand instead of in a power crusher.

To reduce the moisture in the coal by weathering seems to improve the economy, but these tests are not sufficient in number to determine definitely the condition of the fuel and the time required for weathering to insure the best results.

The steam blower for the ash pit is inefficient, and there is no gain in supplying superheated steam to it. A considerable saving in steam and equally good results could probably be obtained by substituting for the steam blower a fan such as is commonly used for forced draft.

As there are a number of lignite seams of coal in Canada, a similar coal being found in the Canadian west, these conclusions will be of interest.

The main point after all is not what a man does, but why he does it.

The Government's Fuel Testing Station at Ottawa

The Dominion Government has Given Great Aid to the Peat Industry by Establishing a Fuel-testing Station, Where Peat is Used in the Economical Production of Power, Using a Gas Producer and Electric Generator. The Total Labor Cost of Producing Peat is $1.63 per Ton. In Canada There are 37,000 Square Miles of Peat Bogs.

IN Canada there are 37,000 sq. miles of peat bogs. To develop the peat industry the Canadian Government has established a fuel testing station at Ottawa and have bought 300 acres of peat land at Alfred, Ont., where there is an area of 3,000 acres. The peat is dug by hand from a trench 3 to 12 ft. deep, and placed on a conveyer which elevated it to the pulverizer. From this machine, in which it is macerated by a series of knives, it is discharged into cable operated cars and conveyed a short distance to another spot on the bog—the drying field. From the cars it was spread out in a layer about 6 ft. wide and 5 in. deep, and the field press, a simple arrangement of weighted rollers with a series of knives following, passed over it. Roller knives are drawn laterally over the layer of fresh peat, thus forming blocks about 10 x 5 x 5 inch. The peat machine has a capacity of 25 to 30 tons per day. When spread out originally peat contains 90 per cent. moisture, and after air drying for three weeks the moisture had been reduced to 25 per cent., a degree of dryness suitable for fuel or use in a gas producer.

According to figures supplied by Dr. Eugene Haanel, of the Department of Mines, Ottawa, the cost of the peat from the bog, including interest on capital invested, amortization, oil and repairs, is $1.65 per ton loaded on cars.

Analyses of the Alfred peat, absolutely dry, show its composition as follows:

Volatile matter	68.23	Sulphur	0.218
Fixed carbon	26.00	Phosphorus	0.033
Ash	5.77		
Nitrogen	1.76	Calorific value B.t.u.	9.005

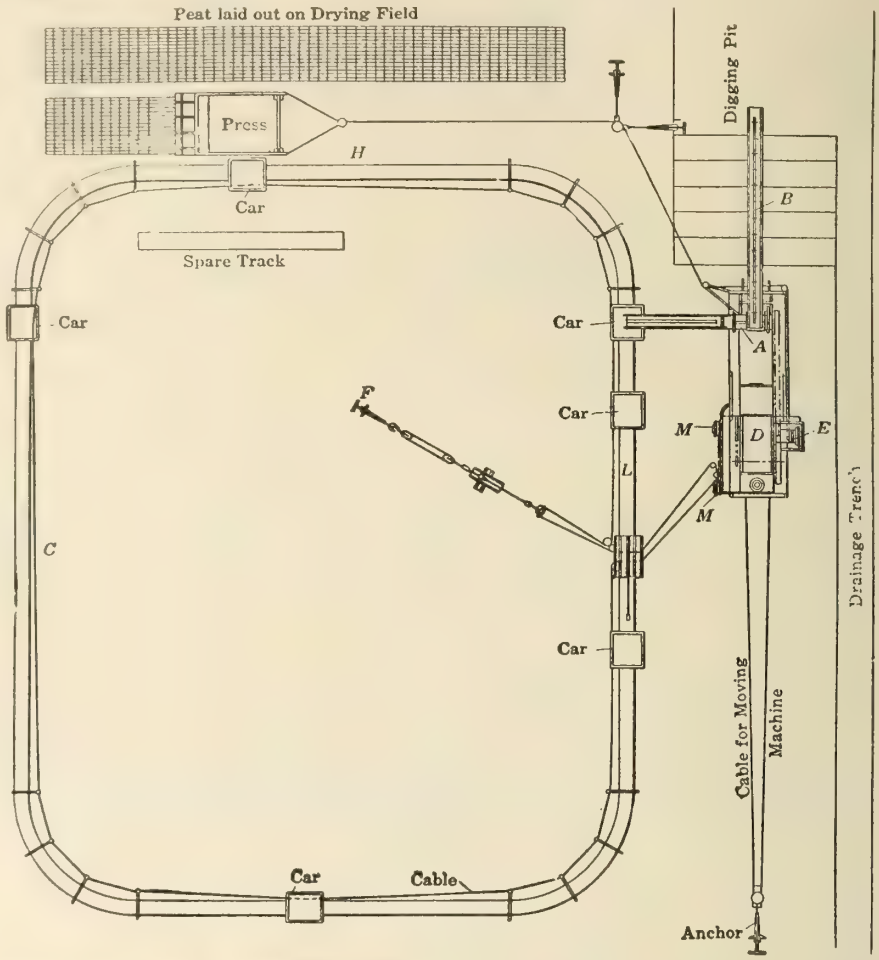


Fig. 1.—Diagram of Peat Field.

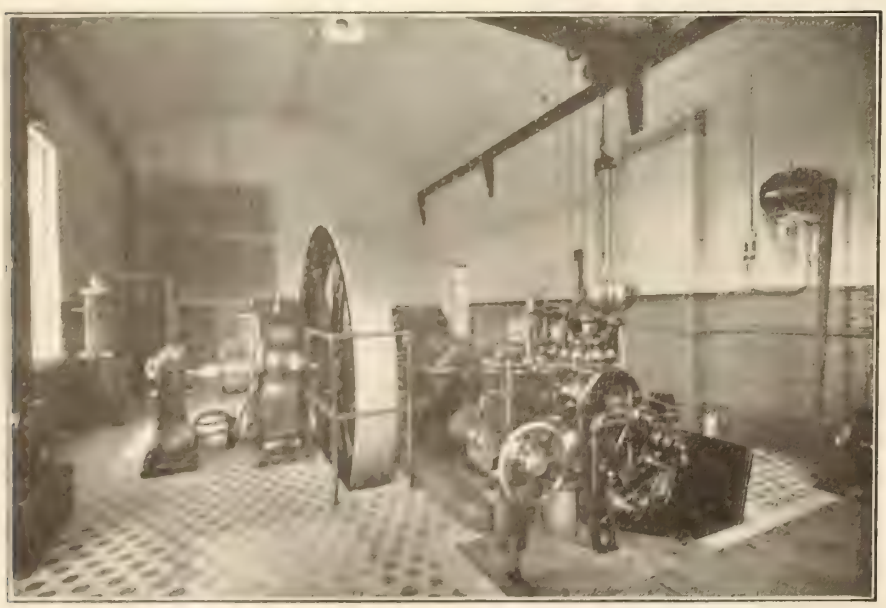


Fig. 2.—A View of the Engine Room.

Adaptability of Peat for Gas Producer Use.

Experiments have been carried on by Dr. Haanel at the fuel testing station and the results are thus summed up by him:

"Air dried peat is not alone an excellent fuel for domestic use, but for the production of power it proves an ideal fuel in the peat gas producer, which is to-day as reliable and efficient in its operation as the coal gas producer. I do not hesitate to say that it is an ideal fuel because the peat from most bogs is free from a clinkering ash and yields, on combustion, a fine white residue, which readily allows of the thorough cleaning of the fire, and the property of not fusing or caking in the producer assures regular operation. Moreover, since gas leaves the producer with a high degree of sensible heat, which must be cooled to the temperature of the atmosphere before being

used in the gas engine, it is exceedingly important that as much of this sensible heat as possible be utilized in the producer itself, in order to increase its thermal efficiency. This is accomplished in coal gas producers by the introduction of water vapor, which passes through the incandescent fuel with the air supplied for combustion. This water vapor is decomposed, yielding hydrogen and oxygen. The latter combines with the carbon of the fuel, forming carbon monoxide. This chemical reaction absorbs a large amount of heat and lowers the sensible heat of the gas, but the heat absorbed in liberating the hydrogen is to a large extent restored and utilized when the gas enriched by hydrogen, is burned in the gas engine or other apparatus."

The Testing Station.

The fuel testing station was erected in 1909. At present it is equipped for testing fuel only. The apparatus consists of a Korting double-zone suction gas producer, a Korting gas engine and a 50-kilowatt Westinghouse direct-current generator. The producer room is large enough to hold additional apparatus and producers of other types are to be installed in the near future. These producers will be especially designed for bituminous coals and lignites. Part of the producer room and the Korting producer are shown in Fig. 2. The producer is 15 feet high, 2 feet 9 inches wide and 5 feet long.

The engine and generator are shown in Fig. 3. The engine is a single-cylinder, four-stroke-cycle machine, fitted with a throttling governor. The diameter of the cylinder is 15 inches, the stroke is 24-in. The speed is 200 revolutions per minute. During tests the current generated by the dynamo is absorbed by either the bank of five hundred 16 candlepower incandescent lamps, which is located on the end wall of the room, or by the iron grid which may be seen against the wall at the left of Fig. 3.

The gas-testing apparatus is located on the right wall of the engine room. A detail view of this is given in Fig. 4. Gas is drawn from the system by a small Root blower and passed through a water-pressure regulator to a Junker gas meter. From the meter the gas goes to the calorimeter which is also a Junker instrument. The average effective heat value of the gas is about 126 B.t.u. per cubic foot. The producer requires from two and one-half to three pounds of peat per brake horse power.

The information in regard to this station is compiled from reports of the Department of Mines, the illustrations being supplied by Dr. Eugene Haanel, Director of Mines, Ottawa.

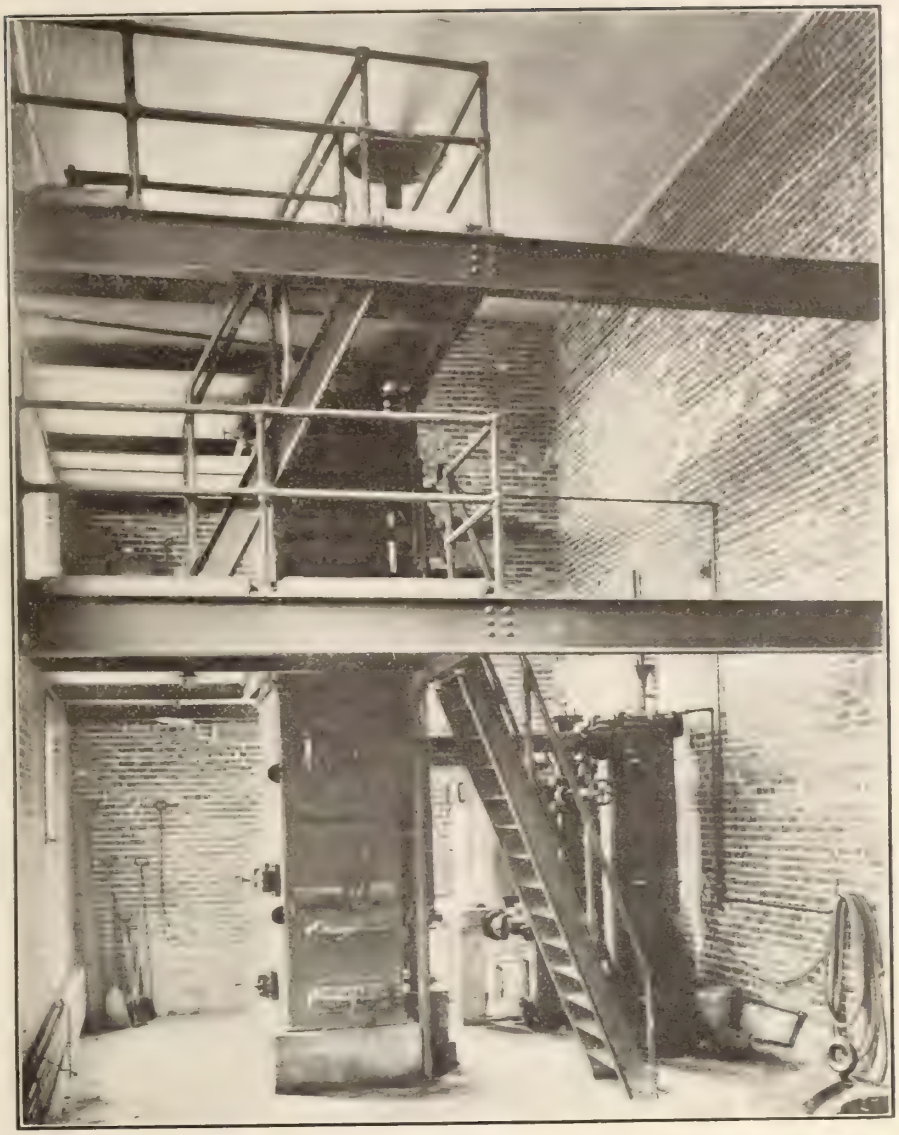


Fig. 2.—Korting Gas Producer and Gas Cleaning Apparatus.

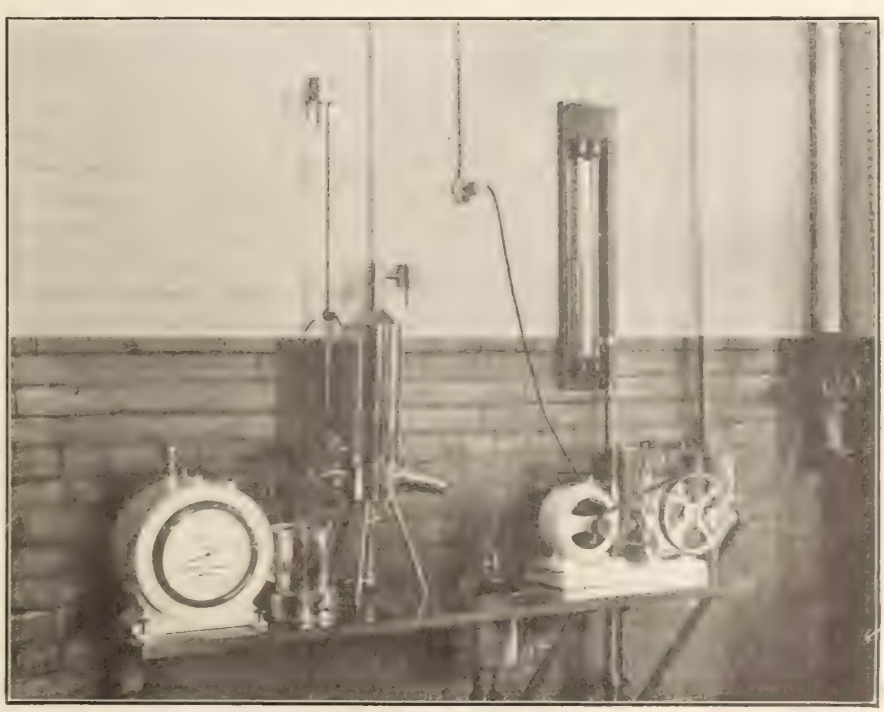


Fig. 4.—Gas Testing Apparatus.

News of Societies

Officers of Engineering Societies and Current News of Associations

The Engineers' Club, of Toronto, have appointed R. B. Wolsey as permanent secretary.

* * *

J. C. Baker, Revelstoke, B.C., has joined the staff of the Merrit Electric Light & Power Co., Merrit, B.C.

* * *

Milton Shantz, formerly of Berlin, has removed to Winnipeg, where he will open up an office in connection with the Diamond Grate Bar.

* * *

Prof Bain, of Toronto University, will give a lecture on the "Chemistry of Coal," before the Toronto No. 1 C. A. S. E., Forum Bldg., Toronto, on Jan. 20th.

* * *

The twenty-second annual dinner of the Engineering Society, University of Toronto, will be held on Jan. 19, 1911, A. D. Campbell is president, and A. H. Munro, cor.-secretary.

* * *

E. A. Jacobson, of Stockholm, Sweden, and for some time with the Allis-Chalmers Co., Milwaukee, has joined the Canadian Boving Co., 164 Bay St., Toronto., in the capacity of hydraulic engineer.

* * *

The Canadian Cement and Concrete Association will hold their annual convention in Toronto, March 6 to 11. Wm. Smith, 57 Adelaide St., Toronto, is secretary.

* * *

The president of the Exhibitors' Association of the C.A.S.E., has appointed V. O. Phillips of the Twin City Oil Co., Berlin and W. G. Walters, Hon. Pres. of the Exhibitors' Association to the entertainment committee in connection with the convention and exhibition in July. These with G. E. Fisher, chairman, and Earl F. Hetherington, complete the committee.

* * *

Canadian Society of C.E.

The Canadian Society of Civil Engineers meet in Winnipeg Jan. 24 to 27 inclusive. The president is Col. H. N. Ruttan, Winnipeg. The program includes a visit to the municipal power plant at Point du Bois, St. Andrew's Locks, and other plants of interest.

The Conservation Committee have undertaken the collection of information respecting the developed and undeveloped water powers of Canada. Forms have been distributed to assist in collecting the data.

* * *

Boilermakers Elect Officers.

Fort Garry Lodge 451, Brotherhood of Boilermakers, Winnipeg, at its annual meeting elected the following officers:—J. Tumilson, president, re-elected; J. Handford, vice-president; J. Hume, financial and corresponding secretary; J. Tumilson, treasurer; J. Waddington, recording secretary; J. Hawthorne, inspector; R. Gardiner, guard; J. Handford, F. Magford and J. Tomes, trustees. The installation was conducted by J. Hume, past president.

DISTRICT AND SOCIETY NEWS.

Devoted to brief reports of the various engineering societies of the Dominion, notices of meetings, reading of papers, license examinations, personal grievances and individual experiences. An exchange whereby through district correspondence, close touch and helpful influence, a mutually educative interest may be aroused and maintained. The co-operation of professional and operating engineers individually and collectively, through the secretaries of the various societies, can do much towards making a feature of this section of our paper.

Toronto Civil Engineers.

At the annual meeting of the Toronto branch of the Canadian Society of Civil Engineers, held on Jan. 6, the report of the retiring executive showed an aggregate membership of all classes at this branch of upwards of 275. These, according to the constitution, are members resident in Ontario within a fifty-mile radius of Toronto. It was announced that arrangements have been completed for the securing of a special car to take the members of the branch to the general annual meeting in Winnipeg during the last week of the month. The election of officers resulted as follows: Chairman, Professor H. E. T. Haultain; Secretary, Mr. A. C. D. Blanchard; Executive, Mr. T. C. Irving, jun., Mr. P. Gillespie, Mr. E. A. James, Mr. W. E. Douglas, Mr. G. G. Powell.

Montreal Notes.

The associate editor appointment is looked upon with much favor here.

* * *

A reformation in the system of examination, and a truer test of competence, is much desired by engineers here.

* * *

Engineer license aspirants want space devoted in your columns to their instruction, and to ventilation of their grievances.

* * *

A lack of unity of purpose between the French and English speaking engineers, results in poor organization for improvement and recognition.

* * *

An absence of serious boiler accidents is a feature, reflecting competence on the personnel of its engineers, and giving inspiration to at least maintain the record, in Montreal.

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The question of an engineers' licensing board, independent of the boiler inspector's department, is still a live one. The Board of Control is likely to have the proposition sprung on them soon. The interests at work, however, make their motives too apparent and personal.

* * *

The Montreal No. 1 Canadian Association of Stationary Engineers, dissolved itself last April, for why? It is said remissness in paying membership dues, and lack of interest by older members who had secured the plums of appointment, were contributory causes.

* * *

Some engineers contend that licenses are too easy to get, resulting in the supply being much in excess of the demand. Others again take the extremely opposite view, claiming that paltry, petty and personal jealousy of competence, acts harshly on them.

(A little more light on the subject, and a little publicity would be advantageous. Both sides please note.—Editor.)

* * *

Queen's Engineering Society.

The Queen's University Engineering Society held their annual banquet on Dec. 20. Those attending included Lieutenant-Governor Gibson, Toronto; T. W. Gibson, Deputy Minister of Mines,

Toronto; A. B. Wilmot, M.A., professor of mining and geology, Toronto; Mortimer Lamb, secretary of the Canadian Mining Institute; J. G. G. Kerry, consulting electrical engineer, Toronto; H. E. T. Haultain, professor of mining engineering, Toronto University; P. W. Sothman, chief engineer of the Hydro-Electric Commission, Toronto; J. W. Kynoch, chief engineer of the Canadian General Electric Company, Peterboro; J. W. Weller, chief engineer of the Welland Canal; R. W. Leonard, President of the Coniagas mine, Cobalt, and A. W. Campbell, Deputy Minister of Railways and Canals, Ottawa.

* * *

Belleville C.A.S.E. No. 34, Celebrate.

The Belleville Lodge No. 34, Canadian Association of Stationary Engineers, held their third annual banquet on Dec. 29 at the new Queen's Hotel, Belleville. About thirty engineers were present and after the supper listened to an enjoyable program of speeches and songs.

The toast master was C. J. Peppin. The first toast was to the King. This was followed by a song "Ida Dunn," by A. Wheeler.

The guest of the evening was W. C. McGhie, the chairman of the Stationary Engineers' Examining Board, and he took the opporunity in replying to a toast, the C.A.S.E., to explain the working of the Ontario Act and the steps that were being taken to enforce it.

He first showed the value of the Act. Men came each week from 100 to 200 miles to try the examinations and he thought that was one proof of the value of it. In speaking of its enforcement he showed how the Examining Board and Factory Inspectors were working together to see that only engineers with certificates, were employed.

He also referred to the C. A. S. E. and the work it was endeavoring to do along educational lines.

Song—H. Cunningham.

Song—"An old negro pastor leaving his flock," by A. Wheeler.

Recitation—Bro. Malloch.

Toast to the Ladies'—Bros. Osborne, Smith, Ketcheson, Welsh and Cooke.

Mr. Peppin urged all stationary engineers to join the association at once. It is quite likely that the examinations for license in the near future will be made very difficult by act of parliament. It had recently been suggested that all electrical, gasoline engineers as well as steam engineers, should be united in an association for mutual help and the preservation of life and property. There are a number of gasoline and electrical engineers in this city and and their work is as dangerous as steam engineering. The association is an engineers' educational institution. Papers are read at all the meetings in order to educate engineers on many points. The more education a man has, the better salary he can command. Mr. McGhie had always been the friend of the society and the speaker hoped the good work which he had initiated would continue.

W. Cooke, secretary, read a letter from J. J. Heeg, Guelph, executive president of the C.A.S.E., urging co-operation among the members and the giving of mutual help.

Other speakers were Bros. Byron Jones, W. Corham, Frank Chesher, Wm. and Harry Williams, and J. Stott also took part in the program.

The program closed by giving a hearty vote of thanks to W. C. McGhie for his address and explanations of the act.

* * *

Engineers' Union, Toronto.

On the last Wednesday of each month, the Toronto Engineers' Union hold an open meeting for engineers in the Labor Temple, Church St. On Jan. 25 arrangements have been made to have to have W. C. McGhie, chairman of the Ontario Stationary Engineers' Board, speak on the workings of the Ontario Stationary Engineers' Act and the enforcement of same.

* * *

Eastern Power Union.

The question of securing cheap Hydro-Electric power for the municipalities along the frontier between Napanee and Cornwall brought a meeting of representatives of nine municipalities to Brockville recently. About thirty-five delegates were present from Kingston, Napanee, Brockville, Athens, Lyn, Prescott, Cardinal, Iroquois and Morrisburg. The Hydro-Electric Power Commission was represented by Chief Engineer H. W. Sothman.

After a good deal of discussion, a union of municipalities was formed for the purpose of co-operating in securing Hydro-Electric power for Eastern Ontario, the understanding being to add if possible, the names of municipalities not represented at the meeting. Mr. Elliott of Kingston was elected president, and Wm. Shearer of Brockville secretary. A rough estimate of what power could be used by the municipalities represented was given, amounting to 5,300 horse-power. The secretary was instructed to ask the Hydro-Electric Power Commission for a price.

* * *

Ontario Stationary Engineers' Board.

Wm. Corrigan of the Ontario Stationary Engineers' Board, visited Chapleau, North Bay and Haileybury, in the last week of December on an examining tour. W. C. McGhie, the chairman leaves about Feb. 1 for Windsor and other points west. Mr. McGhie has been speaking at a number of gatherings of Stationary Engineers recently, and states that he is always ready to speak at any engineers' meeting in Ontario and explain the workings of the Ontario act. He will also be glad to explain by letter if any engineer desires to communicate with him.

The Board has been busy during the past few weeks issuing certificates. Unfortunately a great majority left the mailing of their fee to the last possible moment, so that several thousand certificates had to be registered at once. This, necessarily, caused a great amount of extra work in the post-office and the staff there, being unprepared for such a heavy registration, many certificates were delayed. Engineers who did not receive their 1911 certificates until the middle of January will therefore understand the situation. It would assist the Board and ensure rapid delivery of certificates if engineers would apply for their certificate renewals earlier in the year.

The Factory Inspectors have been given power to enforce the Ontario Engineers' Act. As a result they are investigating any violation of same, reporting each week to the Stationary Engineers' Board. A counter report is made a week later by the latter to the Factory Inspectors showing what steps have been taken to make these violators of the law comply with it. In this way the law is being vigorously enforced.

* * *

Annual Convention

The Canadian Casualty & Boiler Insurance Co., Continental Life Bldg., Toronto, held their annual convention of engineers, inspectors and agents, Jan. 9, 10 and 11, 1911. In attendance were the following engineers: A. M. Wickens, chief engineer, Toronto; J. W. Crowley, St. John, N.B.; J. A. Bourbonniere, Montreal; Chas. F. Wolfe, Brantford; J. O. B. Latour, W. G. Blackgrove and A. E. Hocken, Toronto.

On Monday the engineers and inspectors were given an automobile drive around the city and in the evening the annual banquet was held at the St. Charles. Among those present were C. Norie Miller, manager; J. Durance, assistant manager, and J. McInroy, chief accountant. The general manager addressed the field men on the year's work. Business in 1910 was good, and he was able to report a handsome balance. The losses for 1910 were the lowest for one year since the company started. He extended his best wishes for the New Year to the engineers, inspectors and the company's 82 agents.

ELECTRICITY FOR STATIONARY ENGINEERS

LOW VOLTAGE TUNGSTEN LAMP EQUIPMENT.

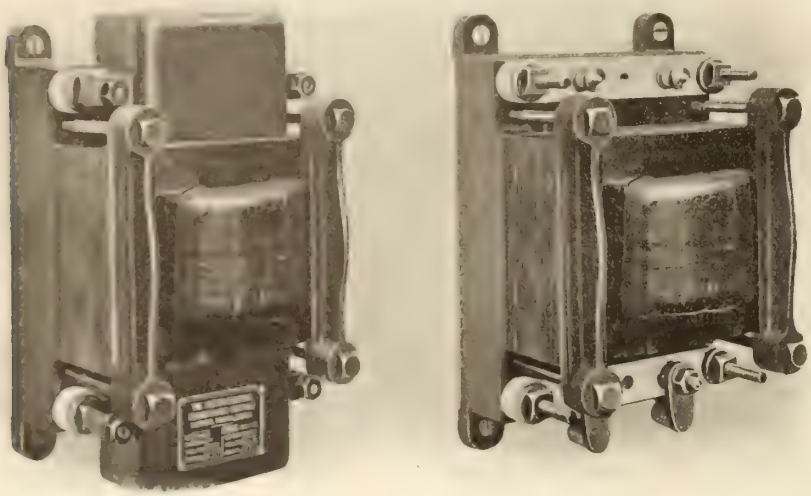
Chapman & Walker, Toronto, recently remodelled the system of lighting, at the woollen mills of Geo. Pattinson & Sons, Preston, Ont. Their original outfit, was a 220 volt, 3 phase, 25 cycle system, with the engine well nigh to over load.

Vibration from the machinery in the buildings, made the desire to install high voltage tungsten lamps, impossible of realization, and the difficulty of properly matching these lamps for series burning, rendered some other method necessary.

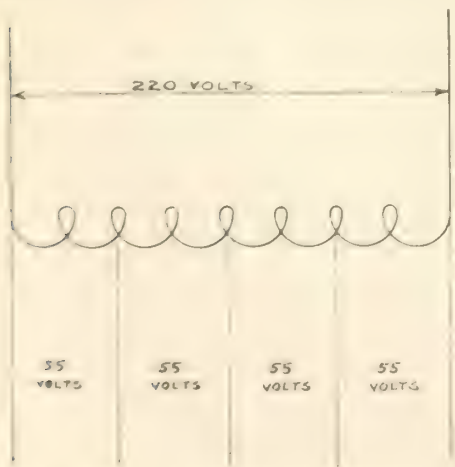
As a solution, air cooled single coil "Berry" type, four circuit balancing transformers, made by the British Electric Transformer Co. were installed, each circuit carrying fifty, 25 watt, 55 volt, Z lamps. By this arrangement the transformer had only to carry the unbalanced lighting load.

The results were highly satisfactory, reducing the engine load, and cutting the operating expenses and lamp renewals, to the extent of one half.

Conditions similar to those originally existing in the Pattinson equipment, are to be found in many other installations, and they should receive competent attention if satisfactory service is desired.



The "Berry" Type. Air-cooled. Single Coil. Four Coiled. Balancing Transformer.



Low Voltage Tungsten Lamp Equipment.

CARE OF DIRECT-CURRENT MACHINERY.

By J. F. Nisbet.

The design of electrical apparatus has now reached such a high point of perfection that troubles of any consequence are happily few and far between. Occasionally a machine will be encountered that develops troublesome faults, the remedy for which is not always easy to locate. Sparking at the brushes is one of the most prolific sources of annoyance to operating engineers in charge of direct-current machinery. Very often this can be traced directly to the brushes themselves, and may be due to any of the following causes :

1. Brushes not set at proper point of commutation.
2. Brushes not properly trimmed.
3. Brushes not in line.
4. Brushes not making good contact.

These are very simple faults and are just as easily remedied. By moving the rocker arm slowly backward and forward, the proper point of commutation can generally be found. The brushes (if of carbon) can be ground to fit the commutator by placing a sheet of sandpaper between them and commutator and working this slowly backward and forward. Care should be taken, however, to follow the periphery of the commutator with the hands, so as not to round the edges of the brushes.

Poor contact is primarily due to a dirty commutator, or to insufficient tension on the brushes. Wipe and clean the surface of the commutator, and adjust the brushes to a light, even pressure, and no further trouble will be experienced from this cause. Finally, the brushes should be adjusted so that they are in line, square with the same commutator bar, and bearing evenly their whole width.

Commutator Troubles.

Under the heading of commutator troubles, can be summarized all the causes of sparking. If the commutator is rough or worn, sparking is practically sure to result, and the only remedy is to turn the commutator down until again perfectly true. One or more high bars indicate that the commutator segments are not properly secured, and the clamping rings should therefore be tightened—after which the high bars, or flats, should be turned off. A weak magnetic field will often produce sparking. This may be due to a broken circuit or to a short circuit in the field coils, and should be repaired as soon as possible.

Other causes of sparking can be traced to abnormally heavy overloads, and to short-circuited coils, or broken circuits in the armature. A short-circuited coil in many cases is caused by copper dust, solder, or other metallic contact between consecutive commutator segments. It might also be caused by imperfect insulation between the clamping rings and commutator bars, or by faulty insulation of the brush-holders. A broken circuit in the armature can be repaired temporarily by bridging the break. This is done by bridging the broken coil with a piece of heavy wire, and in some types of machine can be done while the machine is running, by "staggering" the brushes. This, however, is only a temporary makeshift, in an endeavour to prevent sparking, when it is found impossible to discontinue the run for the time being.

Excessive heating of the armature core is caused by eddy currents, and generally indicates that the laminae are imperfectly insulated. This is entirely a question of faulty construction, and can only be remedied by rebuilding the machine. Excessive heating of the pole pieces is also causes by eddy currents, and is due to faulty construction or to fluctuating current. If the latter, the trouble can easily be remedied by regulating the current.

Heating of Bearings.

Heating of the bearings may be due to any one of the following causes :

1. Not enough, or a poor grade of oil.
2. Dirt, grit, or other foreign matter in the bearings.
3. Rough journals or bearings.
4. Journals too tight in bearings.
5. Bent or sprung shaft.
6. Bearings out of line.
7. End pressure.
8. Strain on belt.
9. Armature out of centre.

The remedy for any of these troubles will readily suggest itself. To relieve end pressure it is necessary to see that the foundations are level, and that the armature moves freely with end motion. If there is no end play, the shoulders on the shaft should be turned down until end motion is obtained. Then line up the shaft and belt so that no end thrust is maintained on the shaft, and at the same time see that the armature has free end play. Belt strain can be relieved by loosening the belt, care being taken, however, to see that it does not slip. In some cases it may be necessary to use a larger pulley and a wider or longer belt. The belts in all cases should be tightened sufficiently to drive full load smoothly without any vibration or flapping of the belt. The machine should always be set so that the pulling side of the belt is underneath.

When the armature is out of centre it may be due to worn bearings which need replacing. The armature should be accurately centred so that an equal air gap is obtained all the way round. If the armature or pulley is out of balance, it is next to impossible to put things right without rebuilding the machine. Sometimes better results can be obtained by carefully balancing on knife-edges and adjusting. Singing or hissing of the brushes can often be remedied by adjusting the carbons in the holders or by applying a little mineral oil or vaseline to the commutator. Very little of this, however, is required. If the belts are found to flap or pound it is best to use an endless belt, or if they must be laced, to use a square joint properly laced. Decreasing the magnetism of the field will sometimes overcome that objectionable humming of the armature teeth as they pass the pole pieces. The fault, however, lies in the design, and is therefore inherent in the machine.

A dynamo may sometimes refuse to generate owing to reversed residential magnetism in the fields. The proper remedy for this is to send current from another machine or from a battery through the field coils in the proper direction to correct the fault. Polarity can always be tested with a compass needle. If the connections or windings are not known, it is best to try one way and test, and if not correct, to reverse the connections and test again. Sometimes a generator will refuse to pick up its load if the brushes are not in the proper position. In a case of this kind the brushes should be moved until the proper position is found. This will generally be found to be at or near the central point.

If it is necessary to shut down a machine on account of a hot bearing, it is essential to get the belt off as quickly as possible, and every effort should be made to prevent the shaft from sticking. When the bearings have been taken out it is best to allow them to cool off as naturally as possible. Cooling off off in water would probably ruin them. Cleanliness about a dynamo or motor is imperative. Dirt, oil, or copper dust may prove to be a source of much annoyance and damage. A good rule is never to allow loose articles to be placed upon any portion of the machine, as they are liable to fall or be drawn into the armature and give trouble. It is a good plan to inspect any machine thoroughly before starting up for a run. It is often the means of avoiding a lot of unnecessary trouble and expense.—Southern Machinery.

ELECTRIC SHOCK.

At the recent convention of the British Medical Association an interesting paper was read on the subject of electric shocks. It has been noted that deaths have occurred due to shocks from 100-volt currents, while at other times a 1,000-volt circuit has failed to kill. It was pointed out that aside from voltage, the amperage and the character of the current, whether direct or alternating, the duration of the shock, and its point of application, must be considered. The resistance of the skin has much to do with the matter, and the effect on one individual may differ greatly from that on another. The condition of the mind is also of importance, for a person who is prepared to receive a shock is less liable to be affected by it than one who receives it unexpectedly and accidentally.

ELECTRIC GENERATING MACHINE TROUBLES.

Undoubtedly, states the Scientific American, the most troublesome parts of electric generating machinery are the armatures and rotors. Insurance records for 1909 placed the armature and rotor difficulties at 40 per cent., and commutator and slip-ring troubles at 29 per cent. In direct-current motors 39 per cent. of the failures were due to the armatures and 31 per cent. to the commutators, while in alternating-current motors rotor defects amounted to 23 per cent., and slip-ring and commutator troubles to 6 per cent., and 49 per cent. of the defects originated in the stator coils.

ELECTRICAL BANQUET.

The second annual banquet of the Electrical Association of the Province of Quebec, held Jan. 12, in Montreal, was a high voltage affair, of several thousand candle power, and the interest neither short circuited not burned out during the whole of the evening.

Over the subsequent speech-making President M. Rubenstein officiated. The toast of "Our Province and City" was proposed by the president and replied to by Acting Mayor Carter.

James Bennett, replying to a toast to the Canadian Fire Underwriters' Association to which J. R. Meadowcroft and J. A. Valois also spoke, remarked on the introduction of measures of compulsory inspection of electrical installations which is now insisted on, and declared the object of the Underwriters' Association to maintain one standard of protection of property and life.

Replying to the toasts to the electrical jobbers and manufacturers, proposed by F. J. Parsons, Mr. Pelcher, of the Canadian Electric Co., severely lectured local men for laxity and neglect of opportunities. Mr. Pelcher declared that the Canadian electrical men were in danger of being swallowed up by the electrical men of the United States by means of the National Electric Light Association, and pleaded for more concerted action on the part of the Canadian contractors.

Mr. Edwards, of the Northern Electric Company, also responded to this toast, and appealed for co-operation.

Toasts to "Our Guests," "Sister Associations," and "Our Association," were spoken to by Clarence Thompson, Mayors Rutherford and Allen, Ald. Leslie Boyd, E. W. Sayer, J. H. Lauer, J. M. Robertson and W. B. Shaw.

Cannot be Surpassed.

I here enclose the sum of $1.00 for my subscription to "The Power House" which I am well pleased with and think that it cannot be surpassed by any of its kind.—WM. FOSTER.

REFRIGERATION DEPARTMENT

MODERN COLD STORAGE PLANT.

A thoroughly modern and up-to-date cold storage plant, operated on the gravity brine system, is now being erected at Brockville, Ont., for the St. Lawrence Produce Co. The original cold storage building which has been in operation for a number of years, was refrigerated by means of natural ice. In the early days of refrigeration in Canada quite a number of cold stores were cooled in this somewhat primitive way. In districts where natural ice was plentiful, insulated buildings were erected, a supply of ice was cut from the nearest river, lake or canal, and a sufficient quantity stored to furnish the cooling medium during the summer months.

As a rule the method of application was comparatively simple. Various devices were however employed to promote air circulation, and in some cases cylinders containing a mixture of ice and salt were used in an attempt to obtain a lower temperature than is possible by means of ice alone.

Although ice melts at a temperature of 32 degrees F., it is impossible to obtain in practical cold storage work, temperatures in the rooms much below 36 deg. to 38 deb. F. As a make-shift, and for certain kinds of produce, that is perhaps better than nothing. There is no doubt, however, that much harm has been done to the cause of refrigeration, and the good name of cold storage has been considerably injured by the very imperfect results obtained in cold rooms operated by means of ice alone.

In the first place nearly all kinds of perishable products require lower temperatures than 38 deg. F., Then the conditions of moisture and the lack of proper air circulation are quite unsuited for the long storage of delicate produce. It is impossible for instance to hold eggs for any length of time in one of these early cold storage buildings, and therefore the pickling vats were largely used. Butter which requires a temperature well below the freezing point of water, could not be successfully handled. These and other articles frequently came out of such establishments in a more or less damaged condition.

The system of refrigeration which is being installed is known as "Cooper's Gravity Brine System.' This is a comparatively recent development by which it is possible to operate cold storage buildings, without the aid of mechanical refrigeration. The method has been thoroughly tested and plants have been working most successfully in the United States abd Canada for a number of years.

The results obtained in the rooms under cold air, where a gravity brine plant is in operation, are similar to the results in a cold storage building operated by means of an ammonia compression machine, a CO_2 plant, or by any other method of mechanical refrigi eration, Any temperature down to 10 or 12 deg. F. can be obtained with a perfectly dry atmosphere, and the system can be adapted to air circulation, or brine circulation as desired.

Gravity Brine System.

The modus operandi is as followsl Tanks containing a mixture of crushed ice and salt are placed at the top of the building, that is at a higher point than the rooms to be refrigerated. These tanks, which are known as primary tanks, contain in addition to the freezing mixture, coils of pipes connected to other pipe coils in the rooms to be cooled. The pipe coils in the rooms are called secondary coils, and are placed at a lower level than the primary coils. The primary and secondary coils are connected by discharge and return brine leads. Contained within these pipe coils is a solution of brine. The refrigeration is caused and the low temperatures obtained by the greater rapidity with which ice is melted owing to the admixture of salt. This freezing mixture, surrounding as it does the coils in the primary tanks, cools the brine contained within these coils. The colder brine, by law of gravity, falls to the lower level of the secondary coils displacing the warmer brine which is forced up, to be in turn cooled and returned by gravity to do the work of refrigeration in the rooms. A constant circulation of cold brine is thus maintained. The conditions are precisely the same as when brine cooled by expanding ammonia is circulated by means of a brine pump.

Instead of the secondary coils being placed directly in the rooms to be cooled, they are frequently located in a separate chamber, known as the coil room, or air cooler. From the coil room the cold air is distributed by means of fans, and ducts, to the various chambers to be refrigerated.

Description of the Works.

The works at Brockville now being remodelled, consist of the original building, which is a substantial brick structure, and an extensive addition on the east side, containing the gravity brine plant, coil rooms, handling corridors, elevator, and ice house, as well as the necessary appliances for crushing and elevating the ice. Provision is also being made for a heating system for cold weather as well as a thorough system of ventilation.

The cold rooms are situated in the old building, the greater portion of which will be operated by means of air circulation. Three coil rooms are provided for this purpose. No. 1 operates the basement, No. 2 the first floor, and No. 3 the second floor. These coil rooms, as previously explained, contained the secondary coils. The air is circulated by fans of special construction, a 45 in. fan being used in the case of coil room No. 1, and 60 in. fans for coil rooms Nos. 2 and 3. The butter rooms in the basement, and the sharp freezer for butter, will be cooled by means of pipe coils placed directly in the rooms. The rooms on the second floor will be used for eggs, and the lower rooms principally for cheese. The distribution of air in these rooms will be arranged to give a gentle and even circulation in all parts, thus making possible the steady and equitable temperature essential for the long storage of eggs and other delicate produce.

The power required to operate the whole of this plant (outside that necessary for the elevator) is as follows: For the ice crushing and ice elevating plant, etc., one 4 H.P. motor, for the air circulating fans, three electric motors, one of 1 H.P., one of 1½ H.P., and one of 2 H.P.

Capacity of the Works.

The total capacity of these cold stores that is the amount of space under cold air, is about 100,000 cubic feet. Of this about 30,000 cubic feet will be used for the storage of eggs. The egg rooms will be kept at a temperature of 30 degrees F. The butter rooms contain 8,800 cubic feet of space and will be maintained at temperature from 12 to 15 deg. F. The greater portion of the remainder of the space will be used for the storage of cheese which will be

held at a temperature of about 35 deg. F.

The ice house is of sufficient capacity to hold from 1,800 to 2,000 tons of ice. The arrangements for handling, crushing, elevating and filling the day's supply into the primary tanks are such that the whole of this work can be accomplished in the space of about three-quarters of an hour.

The insulation of the existing building is being added to and improved, and made suitable for maintaining the lower temperatures that will now be required.

The plans and specifications for the building were prepared by E. J. Greenstreet, F.R.A.I.C., cold storage architect, of Toronto. The gravity brine plant, and the machinery for ice crushing, elevating and handling, as well as the air circulating fans, are being manufactured and installed by the Madison Cooper Co., of Watertown, N.Y.

OVERHAULING AN ICE MACHINE.

By W. G. Walters.

In some cold storage plants, the mechanical refrigerating machine runs the year round. In Canada, where the temperature is below 32 degrees F. four months of the year, it is customary to shut down during this period. This affords an excellent opportunity to overhaul the machine and system.

It is good practice to clear the refrigerating system, and store the anhydrous ammonia in the condenser. This gives an opportunity to overhaul the refrigerating coils, and change lead and liquid pipes that appear to be in a dangerous condition. The refrigerator side of the machine is where the severest service occurs, and where the engineer should first look for trouble.

Starting, he should close all of the suction and discharge valves, disconnect one of the small pipes on the discharge side, leading to one of the gauges and evacuate the machine. The best way to remove the ammonia and get rid of its disagreeable fumes is to connect a short hose to the disconnected pipe, and discharge the ammonia into a bucket of water, changing the contents of the bucket when it becomes aqua. After being sure that the ammonia is all discharged from the machine, and the gauge shows the zero mark, remove the gland, and the old packing that is in the stuffing box. If your gauges do not show the zero mark, after the machine is evacuated, take them off and have them tested.

Next remove the bonnets from the suction and discharge valves, pull out and examine the valves, and you will likely find that they require some attention. The seat and the steel disk should be ground periodically, to ensure high efficiency, for a leaky valve will decrease the output of a machine to a greater extent than is commonly believed.

Leaky suction valves will allow the ammonia to discharge back into the suction side of the machine, as the difference in pressure is usually from 100 lbs. to 120 lbs., between the condenser and the refrigerator sides of the machine, and the ammonia is bound to follow the line of least resistance.

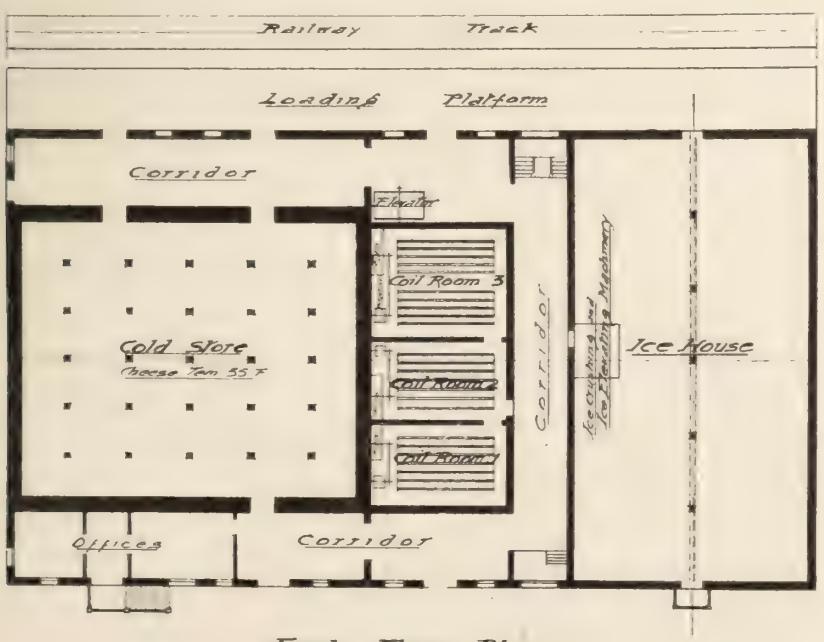
Between the suction valves and the machine, there are screens in the suction pipe which are removed by taking off the covers. Blow the screens out with a strong jet of steam, as they are generally well filled with scale from the coils.

If brine tanks and coils are used as a refrigerating medium, it is a good idea to empty the brine tanks, and clean the coils by scraping, to remove as much as possible of the corrosion that appears on the pipes. A good coating of fish oil should then be applied, as it is one of the best preservatives of iron that it is possible to use in a damp place.

The condenser coils can be done in the same way by scraping and applying the oil. Care should be taken of the insulation on the pipes leading from the machine to the refrigerator, as a great amount of refrigerating effect is lost through defective insulation.

If the system has been in use for a number of years, it would be advisable to change the cocks on the liquid lead pipes. The practice was a few years ago to install iron cocks. Remove all the old iron cocks and valves on the liquid lines, and replace with the improved steel type. These can be packed by opening wide, as they are double seated, and can be packed when in service.

Refrigeration Plant, St. Lawrence Produce Co., Brockville, Ont.



Layout of Refrigeration Plant, St. Lawrence Produce Co., Brockville, Ont.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV JANUARY, 1911 No. 1

"THE POWER HOUSE" AND ITS FUTURE

Will our readers please note and advise all their friends who are not subscribers to The Power House, that we have determined to make our paper, in its "Editorial and advertising" contents, the leading and most complete monthly record of all that its name implies, published for and circulated among engineers, firemen, owners, users, and the engineering profession throughout Canada.

We are daily in receipt of commendation from satisfied subscribers, but much as we may desire and appreciate these, the passing of the "good word" to non-subscribers is the message we seek most of all that you personally deliver.

CONFIDENCE IN YOUR VALUE

From a fairly extended experience of, and association with engineers and mechanics we are forced to the conclusion that 80 per cent. are self-underrated, and never reach out to opportunity when it presents itself. They are working at a pressure more or less below that for which they were designed, educated and trained, with their "safety valve stuck fast" through disuse. They don't cultivate the enthusiastic confidence necessary to make it "blow," and wonder what ails them, when others [illegible] ahead.

On a marine trial trip, it is a source of much gratification to the engine builders and the engine room staff, when the power specified has been attained, "carrying the white feather." For the benefit of our readers who may not understand, "carrying the white feather" means that sufficient steam has been generated to do the work and leave a margin, which shews its presence by lifting and keeping the safety valves in trim, and indicates to the observer by the light fleecy vapour from the waste pipe, [illegible] effort.

It is a sign of capability to do what is presently demanded, and of exuberant enthusiasm to do more. Be ready and able to tackle the peak load. If your best judgment rates you 100 per cent., call it at least 101 per cent., you will carry it comfortably, the extra being just enough to make you think and step lively. A little private testing of yourself will be found effective in stimulating a desire to extend your rating. Just here let us remark that over-rating carried to excess is nothing more or less than misrepresentation, and like a continuously fierce blowing steam safety valve, denotes ignorance of aim and operation. In the nature of things if progress is to be made, it can only be by a reaching out to something beyond, an excess rating of oneself, to an extent governed possibly by the word "reaching." The knowledge we have fits us for more, the ability to perform our present work well fits us to perform other and more difficult work better, and each successive step attained, increases at one and the same time, the possibilities of higher achievement. The knowledge that we are presently delivering the goods is simply the call to do better, and be it in the same capacity or not, the incentive to reach out should always be prominent. Two personal experiences may help to illustrate perhaps more forcibly, what we have been trying to inculcate. The managing owner of a private engineering concern on his usual daily round of the drawing office noted no progress made by the draughtsman, on the lay-out of a loco type marine boiler, from the previous morning.

As a result the work was transferred to a junior.

Neither draughtsman had as a matter of fact any actual experience of the work. The first man lacked however the confidence or excess rating born of cultivation, that carried the second through. He fell to a junior who made good, and who had the honor of laying out the first high pressure boiler (160 pounds) made by the firm. The managing owner was observant, and that junior was kept reaching. The other incident refers to the same junior draughtsman, but under other circumstances. A three-hour written examination for position of boiler inspector (age restriction 28 to 40 for immediate appointment) gave him at 24 years of age, second place out of thirty competitors, and the offer of practically immediate appointment, notwithstanding the age limit set. The experience was a testing of himself, and showed fruitful results in spite of regulations to the contrary, in addition to the elevation of his self-rating to a higher excess point. The distinction between man and man is their own rated value, plus the amount of excess, the carrying of which they have cultivated. If you would progress, and keep in line with and help the world's progress, cultivate and exercise a measure of excess self-rating.

ENGINEERS' LICENSES IN MONTREAL

An aspirant to a 3rd-class engineer's license in Montreal, after commenting on his ability to give the "charmed" answer to that "charmed" question, "how would you line up an engine," voices on behalf of himself and his fellows, a request, that The Power House step into the breach, and by means of a series of "articles," unfold the secret of what constitutes a satisfactory answer to this and other equally insatiable and hoary questions, asked by the boiler inspector of that city.

Our sympathies go out to our correspondent and his companions in their difficulty, and our help in the direction asked will be forthcoming.

To enable us to make the "series" complete and instructive to our wide circle of readers, many of whom

it may be, would like to hear of Montreal's disabilities, personal examination experiences, and questions put, in all grades from firemen upwards, will be appreciated

"THE POWER HOUSE" EDITORIAL INDEX

In the past year we have made many friends and cemented old friendships, among engineers and users of power. We have endeavored to keep our readers informed as to the progress of engineering and as a result, a text book has been issued each month, of great value to our readers. With an increased staff and a larger appropriation for contributed matter, The Power House' in 1911 will be made invaluable to the engineer.

We feel sure that every reader will want to bind Volume IV. for reference and to assist him, we are numbering the reading matter pages during the year consecutively. At the end of the year a complete index will be issued to every subscriber so that any article may easily be found by a reference to it. This is only one of many steps forward, that we shall announce from time to time, and which will doubtless be appreciated by every reader.

ONTARIO ENGINEERS' ACT ENFORCEMENT

When the Stationary Engineers' Act was first drafted and made law, there was no provisons made for its enforcement. At the last sitting of the legislature, the act was amended to read: The Board of Examiners shall "have power to enforce the act and prosecute violation of same." Thus, with the necessary machinery, the board was able to make the act the useful legislation it was intended to be.

In order to properly enforce the act the factory inspectors and the Stationary Engineers' Board have cooperated with the results that the complaints re non-enforcement made to the department, are growing rapidly less.

The method of procedure is as follows: The Factory Inspectors send a typewritten report to the Board every week. At the end of the following week a counter report is made by the Board and this is followed up until the companies or engineers concerned comply with the provisions of the act.

SMOKE

The paragraph "smoke nuisance" on another page is well worth laying to heart, by all who have the ownership, care and operation of steam boilers.

Readers of The Power House will please note, that while smoke is admittedly a serious nuisance, a blur on the landscape, and a perhaps necessary evil, it is not that shocking annihilator of our coal resources that we are always prone to imagine.

Mr. Stromeyer, who has given us this latest word on smoke loss, is at the very top of the steam engineering profession in England, and knows whereof he speaks. Previous to joining the Manchester Steam Users Association, he was engineer surveyor of Lloyds

LEAVING TOOLS WHERE THEY OUGHT NOT TO BE.

A United States naval engineer has been reduced in rank because a left a monkey wrench in one of the cylinders of the ship where he was employed. It was not because the wrench was of much value, and because his Uncle Samuel had to go out and purchase another, but because the wrench was in the way. It wasn't needed in the cylinder. It was foreign matter, not necessary to the running of the engine or to the speed of the boat. It adds nothing to the fighting qualities of the craft, and that is what the Government is after principally. In fact the wrench in the cylinder was a detriment and a hindrance to the smooth working qualities of the boat's machinery. There was no room for it in the cylinder, and when the great engine was started up something, of course, had to go. The monkey wrench being a hard nut to crack, it naturally followed that the cylinder did all the cracking. The cylinder came to grief, and in the common run of things naval the engineer followed the same course.

Some time ago the writer was at a test of a wheel lathe, just finished for a large railroad company. The test was progressing favorably, excellent results were being obtained, when suddenly there was a crash and the centre driving gear and a face plate were broken, necessitating the renewing of both before the test could be continued.

One of the workmen had left a steel wedge that he had used in rolling the axle into place, in the "internals" of the machine and bottled in the segment of the gear. The result was disastrous and both the machine and workman came to grief, the broken part of the gear falling on his pedal extremity thus necessitating a rest from work for some time.

Be sure any carelessness or thoughtlessness will rebound on the engineer or mechanic who is responsible for it. We were sorry for the punishment of both engineer and mechanic, but just punishment was meted out, in the first case by the U.S. naval board and in the second case not by human hands. It should teach us not to leave wrenches in cylinders, wedges in the interior of machine tools or any tool where it ought not to be. In the hurry of work, keep cool always and don't make a cold storage place for tools out of cylinders, machines, etc. If you do be sure the result will be disastrous—to the machine and to yourself.

TOPICS OF THE MONTH

A recent ruling by Judge Hines in the municipal court of Chicago, was so absurd that it would be laughable, were it not so serious. The Cook Brewery Co. were fined $100 for violating the smoke ordinance. They then deducted the amount from the coal bill. The Boston Fuel Co., from whom the coal was purchased, naturally sued the Cook Brewing Co. for the amount deducted. The jury, however, decided that if the user of the coal was fined, he could deduct the amount from the fuel bill. If this is upheld by the superior courts Chicago will be a haven of rest for poor firemen since the smoke by-law will have no effect on manufacturers and the object of the ordinance will be defeatd.

* * *

Toronto recently spent $10,000 in detecting leakages and waste of water. The resultant savings effected amounted to $27,787. This illustrates what a little investigation will bring to light and should put engineers in charge of municipal pumping stations as well as those in charge of industrial power plants on the qui vive.

* * *

The illustration of the skull and cross-bones printed on another page in black, may look like a "black hand" sign, but printed in red it is a great accident preventer.

* * *

In this issue of The Power House. is the first of H. S. Jeffery's series of articles on Boiler Design. The series is written from the engineer's viewpoint and is calculated to make of engineers, not boilermakers, but better engineers.

PRACTICAL ARTICLES BY OUR READERS

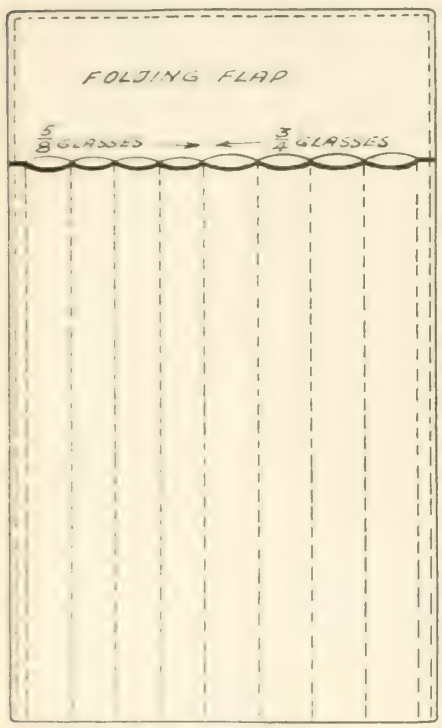
Readers are invited to contribute to this Department with Short Articles and Personal Experiences—We pay for all Accepted Material.

GAUGE GLASS WALLET.

By Ernest Ivie.

The desirability of keeping his gauge glasses clean and free from scratches, led the writer to have made for himself the wallet as illustrated.

It consists of a piece of heavy cloth doubled over, and divided into pockets just large enough to slide the particu-



lar sized glass into, and having the flap arranged to close down over the ends of each. It may be rolled or packed up in a cupboard.

Breakages of gauge glasses are frequently due to scratches received, and with the higher pressures in use now, more attention should be given to precautions for prolonging their life. I hope the simple device may be welcome.

STATIONARY ENGINEERS' WAGES.

Stationary engineers are willing as a rule to talk on most subjects akin to their profession, but on none do they wax more eloquent than that of wages. My letter is not likely to be of absorbing interest to employers, but to us it is always so and will be, until we get rid of the idea that we are underpaid. In Toronto I have seen [illegible] receive more than twelve dollars per week. I [illegible] they receive, although I have discussed the points with our employer. The result of my efforts has been nil, except for the knowledge gained, that those not satisfied can quit. As a rule the engineer has remained on duty during trade strikes and other troubles, and this is partly the reason why the employer underpays. He does not look on the matter as being really a case of loyalty to him, but as an evidence of fear of losing their jobs. Our best thing to do, so far as I can see, is to continue to raise our craft to a higher grade, in the hope that our employers may yet see our value and pay accordingly.

If any open-minded man will look at the license question in a perfectly unbiased light, I believe he will agree that the men have every reason to register a high pressure kick. They have used their time, money and brains to get a government examination law passed which again calls for the exercise of these three valuable things to qualify for examination. They have further to use time and car fare, and pay the government two dollars for a certificate, together with an annual renewal fee of one dollar. Engineers are actually paying the government to protect the public.

Every man must pay for his college or other education, but the engineer is the only working mechanic who has to pay for his certificate. Some States across the line charge a dollar for examination and certificate, but nothing for renewal.

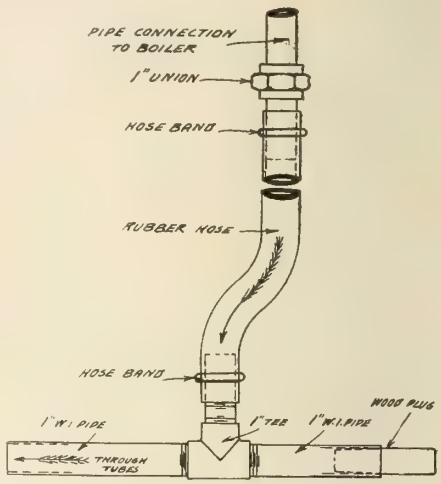
Out of about sixteen thousand engineers, I venture to assert that not more than five hundred get one hundred dollars per month or over. On the contrary many good men receive less than half that amount in outside towns and villages.

Is it any wonder that a man here and there considers himself justified in grafting, when he sees the way he and his fellow engineers are shamefully underpaid, (which is fully as bad as grafting). Of course two wrongs don't make a right, but it is hard to convince everyone that this is so.

HOME-MADE FLUE BLOWER.

By J. F. Parry, Toronto.

The "punching" out of fifty or more 4-inch by 16 feet long boiler tubes on hot summer days, led the writer to devise and rig up the flue cleaner illustrated on fig. 1. The individual items comprising the blower are 10 feet of rubber hose, one 1-inch tee, one 1-inch union, one wood plug, two hose bands, two pieces of 1-inch. piping, each 9 inches



Home-made Flue Blower.

long, one piece of 1-inch piping, one foot 9 inches long, and one piece of 1-inch piping 3 feet 6 inches long. The cost is about a dollar; and no engineer need be without one, although he may have to pay for and make it himself.

POWER AND BABBITT METALS.

IN figuring on the problems in connection with power transmission no economical plan can very well be carried out unless careful consideration is given to the character and quality of the babbitt metal used in the bearings as a means of minimizing the loss of power due to frictional resistance. The first and most vital matter to decide is whether or not it is wise to use a cheap or ordinary grade of babbitt metal because of the initial saving in cost, or whether it is preferable to apply a high-grade anti-friction metal to all of the bearings in a plant. It is true that some bearings are less trying on a metal than other bearings, and for that reason it is often thought that any cheap grade of metal is good enough for such bearings; but is it true economy to do this? The cost of the babbitt metal itself used in an ordinary size bearing is usually infinitesimal as compared with the cost of labor in applying it. The frictional resistance from the use of a low or ordinary grade metal is waste of power that is reflected back to the boiler in causing a greater consumption of fuel. Such bearings are also liable to run hot and have to be kept flooded with oil, and the wear on the shaft and the bearing is much

more rapid. It is very doubtful if these low grade metals have any economic value to the consumer of babbitt. This matter has been threshed out time and again by large manufacturing plants who have found great economy in the use of high-grade metals, effecting in some instances a saving of 33 1-3 per cent. in fuel, 75 per cent. in the consumption of metal and 60 per cent. in oil. Of course, such high percentages could not be expected in every case, but are symptomatic, as showing the possible savings to be effected by the use of a high-grade anti-friction metal. Experience has shown that these same bearings, lined with high-grade metals, will usually run from ten to twenty times as long as the ordinary grades and thereby reduce the cost for labor in rebabbitting to an extent that amounts to a considerable item in some plants. There is also to be considered a reduction in the liability of "shut downs."

Of course, the manner in which a babbitt metal is applied is an essential factor in the results to be obtained. This, however, involves no difficulties whatever, as the directions for using babbitt metals are exceedingly simple and are based upon common-sense reasons. There are really only two important rules to observe in pouring a babbitt metal: First, to have all the preparations ready and pour metal as soon as it is hot enough to char a white pine stick. Originally, when this rule was made it was thought that the metal was injured by overheating, and it is true that superheating any metal does impair its vitality, but, as a matter of fact, it was only within recent years that it was discovered that if a white metal alloy was left in a highly fluid state for too long a time the various ingredients of which it was composed would separate; the lead being the heaviest would gradually settle on the bottom and the tin and antimony would work to the top, and a bearing poured in that condition would have soft spots (lead) and hard spots (antimony). As a babbitt metal is a mechanical mixture, it is very important that it should be poured in a homogenous condition.

The next rule is to heat the box and mandrel. If a metal is poured into a cold box and around a cold mandrel it will check its free flow and produce a poor casting. A cold mandrel produces a thin chill on the face of a bearing, and as this chill does not adhere very tenaciously to its comparatively soft backing it will be torn loose by the grinding force of shaft and slough out of the box. Heating the mandrel also burns off any grease or moisture that may be deposited upon the mandrel by finger prints or from other sources, and if allowed to remain upon the mandrel they will expand into gas when covered by the hot metal, and this gas will hold back the metal and cause a blow-hole in face of bearing. However, the cheaper or ordinary grades of metals are liable to contain ingredients that produce blow-holes no matter what precautions are taken to prevent.

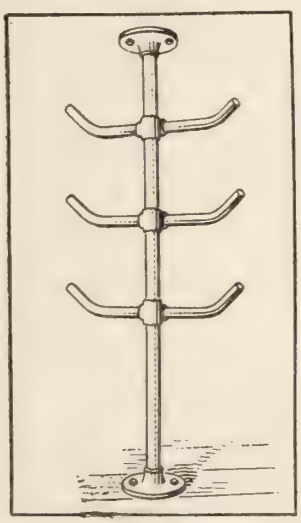
These two simple rules cover practically all the law and gospel of babbitt pouring. There are several other points of minor importance to be observed. If possible, a metal should be peened before it cools off, as a hot metal yields more readily to the blows of a hammer and there is no danger of ever cracking it. Any oxide or scum should be held back and not allowed to enter the box. When a metal begins to change from a silvery to a yellowish tinge indicates the best time to check the heat.

The lack of a proper knowledge of these simple rules has frequently resulted in a good metal being condemned, or failure to secure maximum results. The importance of reducing frictional resistance as a means of gaining an increase of power is obvious. It will often save the necessity of over-loading the boiler, besides the other advantages and economies pointed out. This subject is well worth the careful consideration of every user of babbitt metal.

RACK FOR PIPING.

By M.E.D.

An excellent pipe rack is shown in the accompanying illustration. The upright may be of, say, ½ in. pipe with crosses as indicated and flanges top and bottom. The bottom flange is anchored



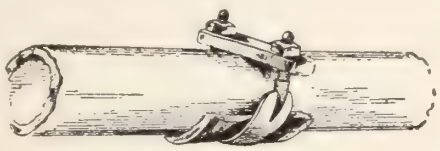
A Pipe Rack Standard.

into a concrete base flush with the cement floor of the cellar. The top flange is fixed to a ceiling beam and acts more or less as a brace to the standard. The branches are carried horizontally as indicated and then given a slight bend upward so as to prevent the piping held in storage from falling from the rack. The branches may, of course, be of 2-in. pipe for a rack requiring to hold a considerable amount of piping.

REPAIRING STEAM OR WATER PIPE.

By Engineer.

A pinhole will occasionally cause a leak in a steam or water pipe after the piping has been put up and perhaps been in use for a considerable time. It can be repaired with an ordinary carriage clip and yoke and a bit of sheet rubber



Mending a Steam or Water Pipe.

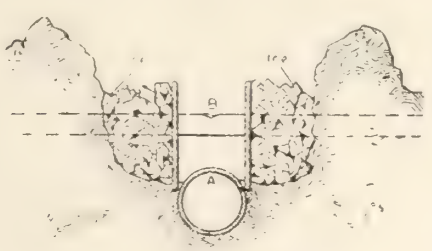
packing, although a piece of an old rubber shoe would last for years.

You can readily see the application by referring to the sketch. The writer stopped two leaks in steam pipes fifteen years ago by this method. The pipes have been in service ever since, and have not leaked. They were both in rather inaccessible places, where it would have been difficult to renew the pipe. At the same time, being in out-of-the-way places, the appearance of the patch did not matter.

REPAIRING WATER MAIN BY FREEZING.

By Frank L. Walter.

In removing an old water main the workman doing the digging accidentally hit a lead pipe branching from the new main, making a hole from which the water flowed quite freely. As it was impossible to shut the water off, a difficult problem presented itself as to how



Freezing the Water Main.

the leak could be stopped and the pipe repaired.

In the accompanying sketch, A shows the main that was being removed and B shows the break in the lead pipe where the workman pierced it with a pick. Ice and salt were packed around the pipe which slowly froze the water within and stopped the flow. This enabled the men to solder up the hole, after which the ice was removed and the frozen water allowed to thaw.

Correspondence

Discussion on Previous Articles—Readers' Queries and Comments. Remuneration for useful Ideas

QUESTIONS AND ANSWERS.

Questions and answers in December issue are a great help and should be continued in each issue.—S. Burgess.

A page of questions and answers will be given in each issue during 1911 and we trust our readers will find the information given in this manner of great assistance.—Editor.

MISCELLANOUS QUERIES.

By A. F. Moray.

1. At what point in the stroke of an engine is the steam pressure the greatest on the cylinder head studs?

2. What advantage does the gridiron type have over the plain slide valve?

3. Does the brombo pulley make a lever reducing motion more accurate?

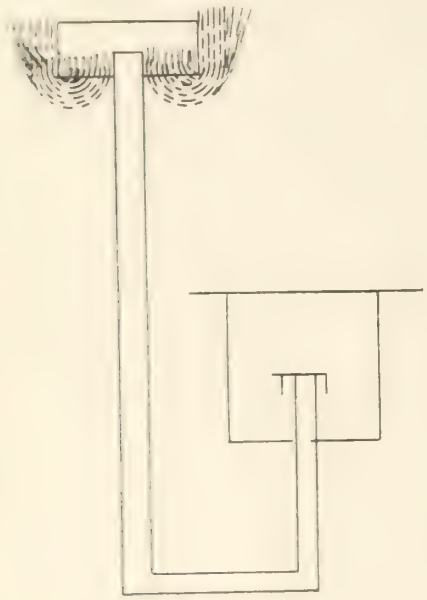


Fig. 1.—

4. Which is the more economical, a barometric or a spiro-ejector condenser?

5. As every pulley has a certain amount of centrifugal force, according to speed, will there be less weight on the bearings when revolving full speed?

6. Nearly all boilers have to be blown off during service. Would long lengths of pipe and sharp bends, after passing the stop-cock, be safer and cause less [illegible] let?

8. How many quarts of medium grade cylinder oil should be used by a 100 H. P. single cylinder condensing engine, 100 lbs. steam pressure in 24 hours? The steam passes through a separator.

9. Is there a trap on the market that will discharge the water from the receiver of a compound engine, when the receiver pressure is below the atmosphere?

10. Why is a good vacuum more necessary with a steam turbine than with a steam engine?

11. What effect has a short connecting rod on the valve setting?

12. A tall chimney is expensive. A fan engine uses a considerable amount of steam. Which is the more economical?

13. Why is a tank pump the most economical for raising water?

14. A syphon constructed with a larger opening on the discharge side, will of course have a greater weight of water. Will it deliver any more water regardless of friction? See Fig. 1.

15. As strains in a boiler are set up by heating and cooling off, would a boiler have a longer life if kept under steam continuously, if practicable?

16. How is it that you get compression on a condensing engine when you have nothing but steam in a vacuum to compress?

ALBERTA STATIONARY ENGINEERING REGULATIONS.

What are the necessary qualifications for first, second and third class stationary engineers' certificates in Alberta?—W. M. White, Truro, N.S.

The act provides for obtaining a certificate of qualification in Alberta in three ways:

1st. Any person who holds a certificate of qualification as an engineer from any incorporated body authorized to grant such certicates of qualification for operating steam boilers and engines or from the Dominion or any Provincial Government or from any competent authority in any other portion of the British Empire or the United States of America shall be entitled, upon making application to the Minister accompanied by such evidence of his qualification as may be required by the Minister and upon payment of a fee of $5, to obtain a certificate of qualification as an engineer in the class determined by the Minister.

2nd. Those who have had over one year's experience in charge of and operating steam boilers and engines outside of this province, upon furnishing evidence of the fact and passing an oral examination before an inspector, can obtain Provisional Certificates, which entitle them to act as engineers to operate steam boilers and engines of any capacity not exceeding 35 horse power for one year, and at the expiration of such certificates, if the holders desire to continue to act as engineers, they have to undergo a written examination for 1st, 2nd or 3rd Class Certificates, as may be determined by the Inspector. The fee for a provisional or final certificate is $5.

3rd. Persons who have had no experience in operating steam boilers and engines, but who desire to become engineers, can do so by serving as apprentices for one year to an engineer or engineers who are registered as holders of 1st, 2nd or 3rd Class Certificates for the Province, and at the expiration of such time passing an examination before an Inspector.

Examinations for final certificates are held from time to time at various points throughout the Province by the Inspectors, and persons desiring to undergo an examination should notify the inspectors or the undersigned so that they may be informed of the next date of examination.

The names and addresses of the inspectors are: Joseph Buxton, Calgary; W. D. Watson, Red Deer; Jno. T. Watson, High River; David Fraser, Strathcona; E. Davy, Medicine Hat; F. W. Hobson, Edmonton, and Nat. Marshall, Lethbridge.

Persons undergoing a written examination are examined as to their knowledge of the construction, care and operation of steam boilers and engines, also a certain list of theoretical and practical questions. Any candidate through lack of education may be allowed to secure the services of a person who will write answers to questions, or interpret only as instructed by the candidate, but such person or interpreter shall not be an engineer.

Candidates writing for a 1st Class Certificate must obtain 70 p.c. of the total number of marks allotted, those writing for 2nd must obtain 60 p.c., and for a 3rd 50 p.c. in order to pass. Those who fail for 1st but made 60 p.c. of marks allotted may be granted a 2nd

Class Certificate, and those making only 50 p.c. on 2nd may be granted a 3rd Class Certificate.

Candidates failing to pass may not again write for the same or a higher class certificate until after the expiration of one year.

For the guidance of those who may desire to present themselves for examination for certificates as engineers, the following information is given regarding the subjects of examination.

The questions are, as has already been stated, of both theoretical and practical character and may be divided as follows :

(a) Questions relating to the origin of steam and its uses.

(b) Questions relating to the different kinds and manner of constructing boilers to generate steam, including the strength of material used in making boilers, and the proper proportion in sizes and thickness of materials to be used, together with proper areas of grate, etc.

(c) Questions regarding the different kinds of safety valves for controlling the pressure in steam boilers and other necessary fittings.

(d) Questions regarding the proper methods of raising and maintaining steam in boilers and the care necessary to keep them in good order, and when repairs are necessary the method of making such repairs.

(e) Questions regarding the kind, construction and operation of the different appliances used to feed and supply boilers with water during operation.

(f) Questions regarding the different kinds of engines used in developing steam, including their construction and the methods of calculating their power and the proper methods of caring for and operating such engines.

The questions are made as clear and concise as possible and every effort has been made to make the questions cover such theoretical and practical knowledge as should be possessed by every engineer charged with the care and operation of steam boilers and engines.

Candidates desiring to qualify for examination can obtain the necessary theoretical information to enable them to answer the questions by studying any recognized text book on the boiler and steam engine, such as Thurston's complete text books ; "Practical Points," by John Farnum ; "Henry C. Tulley's Handbook on Engineering," (sold by the MacLean Publishing Co., 143-149 University Ave., Toronto).

Forms of application and any additional information may be obtained by addressing John Stocks, Deputy Minister of Public Works, Edmonton, Alberta.—Editor.

SOME MAY NOT KNOW.

Full and correct answers to the questions asked under this head, were received from A. Kastella, chief engineer, G.T.R., Stratford.

Advantage will be taken of our "explanation of principles" and "question and answer" departments, to deal furthere with the subject.—Editor.

SMOKE STACK.

Kindly compute height and diameter for a smoke stack for two return tubular boilers 14' x 60" with 60 three inch tubes—Saskatchewan Subscriber.

Simple rules to follow are as follows :

(1) Area of smoke stack should equal the combined area of the boiler tubes.

(2) Height of smoke stack in feet (location conditions being otherwise convenient) should equal twice the stack diameter in inches.

These give a diameter for the above stack of 30 ins. and a height of 60 ft.—Editor.

WHAT WOULD YOU DO?

What would you do, if you put the only big wrench you had in the plant on to the blow-off valve and opened it, then as you started to shut the valve, your wrench broke ?—L. V. T.

KNOT OR NAUTICAL MILE.

How many feet are there in a knot and what is the derivation of a knot ?—Landlubber Subscriber.

The British Admiralty knot or nautical mile is 6,080 feet. The statute knot is 6,082.66 feet, and is generally considered the standard. The method of computing the number of feet in a statute knot is as follows : The circumference of the earth is divided into 360 degrees, each degree containing 60 knots or (360 x 60) 21,600 knots to the circumference ; 21,600 divided into 131,385,546—the number of feet in the earth's circumference—gives 6,082.66 feet as the length of a statute knot. One knot is 1.151 miles, a statute mile being 5,280 feet.—Editor.

GIVE YOUR NAMES.

(Correspondents please note, that we insist on your names and addresses accompanying all contributions, as a mark of good faith. Names or initials are not published unless desired.—Editor.)

THE SMOKE NUISANCE.

C. E. Stromeyer, chief engineer of the Manchester Steam Users' Association, in a memorandum just issued, makes some very pointed observations, on what is popularly known as the "smoke nuisance."

He found in a recent boiler test, with the chimney emitting dense black smoke, that only one per cent. of unburnt carbon escaped. The result in this case, is not the first of a like nature, but coming as it does from one so well qualified to speak, the educational effects should be far-reaching.

A contemporary sums up the popular view on "the smoke nuisance" as follows : "Zeal, rather than knowledge, is we fear, the distinguishing characteristic of most of the enthusiasts who support smoke-abatement societies. To them smoke is not merely a nuisance, but a sinful waste of the fuel resources of the country, which they picture as being poured in an unconsumed state, out of our factory chimneys, at the rate of countless tons per annum."

Smoke nuisance agitations carried on, and supported by boiler and smoke inspectors, who ought to know better, but unfortunately do not, result in most cases, in an increase of unburnt carbon being given off. Factories are fined for emitting smoke, not nearly so dense says Mr. Stromeyer, as that observed during this particular test.

Conformity to the inspector's standard, leads to the easy, common but stupid remedy, of admitting an excess of air for dilution purposes, and to a consequent increase of steaming cost, by an increase of heat loss.

Complaint is made too, that large and high chimneys are usually spotted by inspectors as smoking continuously, and while the latter feature may be very true, probably less contamination of the atmosphere is taking place than would be if each furnace had its own chimney.

Mr. Stromeyer further remarks, that sulphuric acid, invisible yet highly injurious in many ways, is a constituent of the gases of coal combustion, and is emitted in as large quantities in the aggregate from private houses as from factory chimneys.

AN ENTHUSIASTIC READER

Mr. J. W. Mold, Silver Stream, writes as follows :—"I would like to say that I have been a subscriber to several well known trade journals published in England and the United States for the past 18 years. But for the practical engineer I consider "The Power House" the best I have yet seen."

We do not hold ourselves responsible for the ideas put forward, sentiments and opinions expressed by our correspondents.—The Editors.

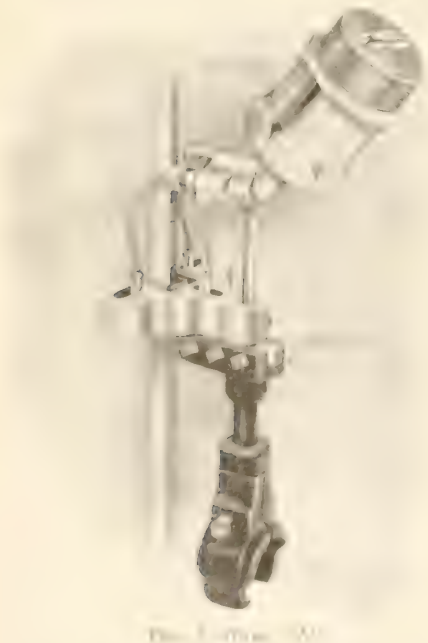
NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

ELEVATOR GUIDE LUBRICATORS.

The lubrication of the guides of elevators has always proved to be a more or less dangerous and wasteful operation. The usual method has been, and is, to have a man travel on the top of the car with a pail of grease or oil, applying the lubricant either with a swab-stick or a brush. With this method employed it is next to impossible to apply only sufficient lubricant necessary for the shoes of the elevator or counterweight. It is here that the waste of lubricant enters into consideration. That portion of the lubricant which goes on the guides outside of the path of the shoe is lost and the lubricant which is placed in the path of the shoe is necessarily applied in such quantities as to have the excess pushed off by the motion of the shoe. This excess lubricant is often splashed on the walls of the elevator shafts making an unsightly mess and oft-times falls on the passengers in the car making the owner liable for damages.

The danger to the workingman applying this method has been clearly demonstrated by the numerous accidents which have taken place in various elevator shafts consisting of broken arms, fractured skulls and in some cases complete [illegible]



The Imperial elevator guide lubricator was designed with the end in view of [illegible] this antiquated method of lubricating the guides.

The lubricators are made in three types all combining the same distinctive features, but being applicable to the various conditions as to width and depth of guides, and the various makes of elevators.

Fig. 1 shows a type "A" machine for counterweights, the only difference between this and the type "A" for cars being the size; the counterweight machine is smaller. The grease reservoir is fastened to the body of the lubricator by means of the central distributor and standard. From the central distributor the grease is fed, by means of flexible conduits, to the front and side distributors which place the grease on the sides and front of the rail.

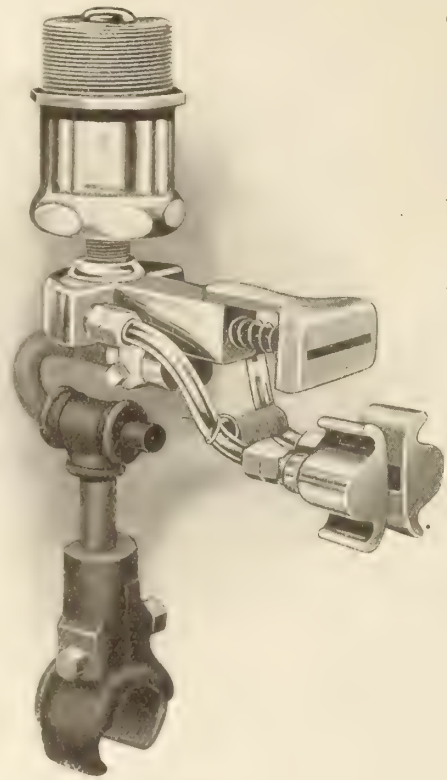


Fig. 2.—Type "B"

These distributors are contained in pockets in the body of the lubricator and are held against the rail by suitable springs. These springs allow for the lateral movement of the car and always hold the distributors in contact.

The attachment to the car, as shown, is meant to grip the shoe spring cylinder, but different attachments are rendered necessary by different conditions and makes of cars.

Type B lubricator is shown in Fig. 2. This is an universal type, by which is meant that it will adjust itself to width and depth of guides that are not of standard dimensions. The conduits for the side distributors in this type are made of solid seamless steel tubing and the distributors are held against the side of the guides by a spiral tension spring connecting the two tubes. The front distributor is also held in contact with the guides by a spring, but this distributor issues directly from the body of the lubricator.

The type "C" machines as shown in Fig. 3 is the standard for rails ⅝-inch up to 1-inch in width. In this type the tube conduits are done away with and the body itself, being hollow, forms the conduits for the grease to the distributors.

The attachment to the car is very simple and the machines can be put in place in a very few minutes.

One filling of the grease cups last from six weeks to three months, depending upon the height of the building supplied by the elevator and the number of trips per day. All the adjusting that is necessary is to slack back the nut on the cup and tighten up two or three threads once a week, the operation consuming less than two or three minutes a cup.

The lubrication of the guides by hand will enable the maximum efficiency to be gotten out of the car only for the first few trips after the lubricant has been applied. Every succeeding trip the power required for the same lift will gradually become greater and greater as the lubricant becomes less and less efficient, whereas with the Imperial elevator guide lubricator the lubrication is done every trip of the car and consequently the power required for lift is

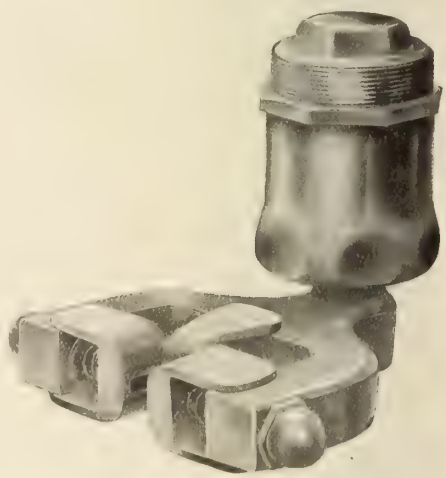


Fig. 3.—Type "C"

kept at a constant minimum. Thus a steady saving in power and wear and tear is effected.

These machines are made in Canada by Power Economies Limited, Montreal, who own the Canadian patents. Their agencies are: Maysmith & Lowe, Vancouver, B.C.; Robert Black, 7 Home Bank Building, Winnipeg, Man.; and Norman S. Jarvis, 602 Carlaw, Bldg., Toronto.

AN OMISSION.

Referring to the descriptive article on page 58 of our December issue, dealing with specialities of the Ohio Blower Co., we omitted to state that the Standard Engineering Co., 47 Wellington street east, Toronto, are the sole Canadian representatives, and that they are manufacturing under license, the various specialties described.—Editor.

IMPROVED STOKER.

The Taylor stoker has been developed to dispose of the refuse so readily that coal can be burned in the large quantities necessary for operating boilers at double their rated capacities. It makes possible the concentration of load on a few boilers and the minimizing of losses by maintaining intense fires and rapid circulation. It thus meets the conditions of what undoubtedy will be the boiler practice of the future.

The difficulties encountered in the disposal of the large amounts of ash resulting from high rates of combustion have been overcome in the Taylor by feeding the coal beneath the burning fuel, at an angle to the fire surface, so that gravity is utilized in carrying the burned-out coal to the dumping plates at the rear as well as in the distribution of the fuel.

The recent changes made relate principally to the operation of the lower line of plungers, which push the burned-out coal onto the dumping plates. The travel, or length of stroke, of the upper row of rams which assist gravity by pushing the coal outward into the fire is constant, but the travel of the lower row can be increased to push the refuse out more rapidly just after the dumping

Section Taylor Stoker Grate.

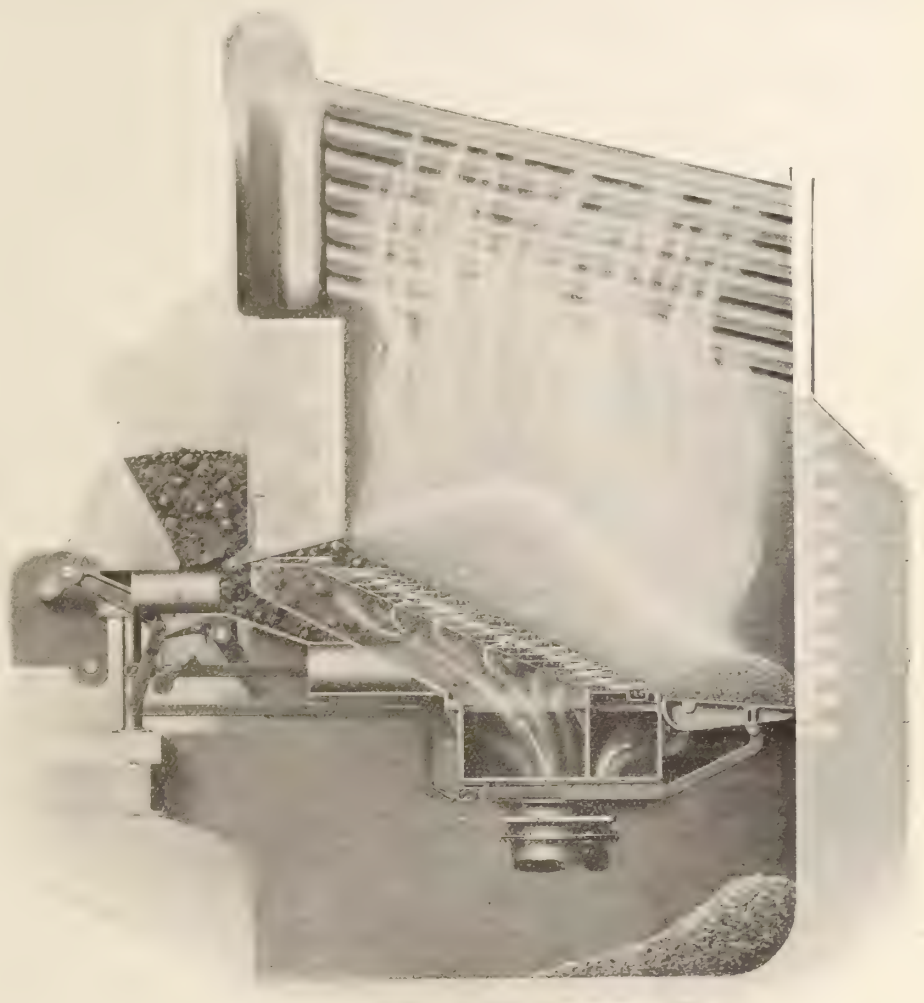
plates have been dropped, or whenever it is desired to more quickly get rid of the refuse which has collected in the lower part of the furnace.

As previously built, each lower ram was connected directly to the bell crank which operated the upper plunger. Adjustment of the stroke of the lower plungers was made for each separate retort. With the improved mechanism, the travel of all the lower rams may be lengthened or shortened simultaneously. This is accomplished by means of a sort of pantograph lever connection having a cam and balance weight on the upper member as shown in the sectional view of the furnace. Pivoted to the plunger connecting rods these cams are connected by means of chains, lever arms and shaft to the operating handle at the centre of the stoker. To alter the travel of the lower rams the adjusting lever is dropped, releasing the cams and permitting them to become horizontal, which action lengthens the stroke of the plunger. In case the vertical connection of the bell crank lever is in such position that the cam cannot drop, it merely remains at rest until the connection moves backward and the counter-balance weight falls and carries the cam into position.

Another change which simplifies the operation of the stoker is the relocation of the speed shaft sprocket. It is now placed at the end of the stoker with the clutch and face plates which hold the shearing pin on the outside. This greatly facilitates the replacing of the shearing pins when required and also the throwing of the stoker on or off the line. It also improves the connection to the fan shaft.

A third improvement is the alteration of the dumping plates. In early forms, the dumping plate was cast in one piece but the present design calls for a dumping plate in sections which are independently renewable, facilitating and lessening the cost of repairs. Improvements of minor importance but which nevertheless make for simplicity, more certain operation, and reduction of repair charges, are the use of lock nuts in all places where possible jar would tend to loosen ordinary nuts, the fitting of the crank shaft brackets to the ram boxes with body-bound bolts, and an increase in the size of the gears in the gear boxes and shafts and bearings. To insure more certain connection between the cast-iron ram boxes and the tuyere boxes they are now carefully doweled together.

The Taylor stoker is made by the American Ship Windlass Co., Providence, R. I.



Section Showing Working of Improved Taylor Stoker.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia

POWELL RIVER—The Powell River Paper Co. is establishing large works at Powell River, 75 miles north of Vancouver. A cargo of machinery, sent by way of Cape Horn from New York, arrived about a week ago. The new paper mill the company is building is to have a capacity of 100 tons of news print per day. There will be a ground pulp mill and a chemical pulp mill. The water power developed by the company is to be 68,000 h.p. A capital outlay of $2,800,000 is being made upon the company's various works.

Alberta

CALGARY—The city is considering the expenditure of $50,000 on a new incineration plant.

Saskatchewan.

SOURIS—Up to February 1 tenders will be received by J. W. Breakey, secretary-treasurer of Souris, for the delivery next spring and summer of water pipes, hydrants, gate valves, valve boxes, pig lead, oakum, standard vitrified sewer pipe, etc., for the municipal water works and sewage system.

REGINA—G. H. Broughton, civil engineer and surveyor, has opened an office in the Princess Theatre Block.

REGINA.—Tenders are asked by the City of Regina for the supply and installation of any or all of the following, together with the necessary connections ready for operation: 1 1500 k.w. steam turbine generating unit, 1 500 k.w. D.C. generating unit, 2 500 horse power boilers, 1 economizer, 1 hand power traveling crane, 1 coal and ash conveyer. Tenders will be received for the above until noon, Tuesday, January 31, 1911. Specifications and all information will be furnished on application to E. W. Bull, City Electrician, or to A. J. McPherson, City Commissioner.

Manitoba

WINNIPEG.—Sealed tenders addressed to the chairman, Board of Control, Winnipeg, Canada, will be received at the office of M. Peterson, secretary up to 11 a.m., on Monday Debruary 6th, 1911, for the manufacture, delivery and erection complete of two pumping plants each of a capacity of one million imperial gallons per 24 hours. Specifications and forms of tender, together with conditions governing tenders as prescribed by by-law, may be obtained at the office of the City Engineer, 223 James avenue, [illegible]

WINNIPEG—The Winnipeg Board of Control accepted the tender of the Seamens Dynamo Works, Toronto, on the recommendation of the consulting engineers for the 500-kilowatt generator sets for the power station. Their tender [illegible]

Ontario

HAMILTON—The 8,500-h.p. generator the Dominion Power & Transmission Co. have decided to add to its works at De Cew Falls is to be built by the Canadian Westinghouse Co., Hamilton. It is to cost about $200,000, and it is not expected to be ready for use until next autumn.

TORONTO—The Canada Foundry Co., Toronto, which has the contract for building the Dominion Steel Corporation's No. 8 blast furnace, is now starting upon that work, the foundation being prepared. The company has also the contract to build the corporation's two 500-ton open hearth mixers. It is at work upon the buildings, producers, gas main and stacks for that [illegible] The mixers [illegible]

been completed at the company's Toronto works, are about to be shipped. The company's engineers were at Sydney recently conferring with the management respecting the construction of still another blast furnace.

BERLIN—The light committee have fixed the rate for residential lighting by Hydro-Elteric power. There will be a fixed charge per 100 square feet of the area lighted, of 5 cents per month, and in addition a charge per kilowatt hour of 4 cents. This is subject to a discount of 10 per cent. if paid in a month, and to a further discount of 10 per cent. if paid in 10 days. The reduction from present rate is estimated at about 7½ per cent., or in other words, the present rate will be about 9½ cents per kilowatt hour.

OTTAWA—A ten-million-dollar company, with head office in Toronto, and authority to carry on hydraulic and electrical power business throughout Canada, has been federally incorporated under the name of the Central Canada Power Co. The incorporators are nominally given as Strachan Johnston, R. H. Parmenter, A. J. Thomson, W. S. Morlock and N. B. Wormwith, members of a Toronto legal office.

BOWMANVILLE—On Dec. 27 a by-law was carried to grant a franchise to the Seymour Power & Electric Co.

GUELPH—The waterworks surplus for 1910 is $18,000.

BROCKVILLE—The waterworks surplus for 1910 is $9,771.60. Deducting debentures, etc., the net surplus is $2,406.92.

HESPELER—The by-law to raise $4,000 for the extension of the electric light for street lighting was carried.

LISTOWEL—The by-law to raise $5,000 to complete the electric light system was carried.

WATERLOO—The by-law to raise $40,000 for electric light purposes was carried.

HESPELER—The by-law for $4,000 to extend the water and light system carried.

COBALT—The engine room, boiler house, and machine shop at the Bartlett mines, Gowganda, have been burned down. The plant cost altogether $30,000 to purchase, haul in, and instal. It includes two 80-horse power boilers and a ten drill compressor.

Arrangements have been completed whereby the Maloney Electric Co., St. Louis, Mo., will shortly establish its Canadian headquarters in Windsor, Ont. The company manufactures electric transformers, and already has about half about half a million dollars' worth of Canadian orders on its books, which has made necessary the establishment of a Canadian branch. Fifty hands will be employed at the start.

Montreal Vulcan Tube Cleaning Systems, 204 St. James St., Montreal, report that they have been doing a very good business in connection with their Vulcan Soot Cleaners in several sections of the country. They are now represented in Winnipeg by J. L. Neilson & Co., the well-known machinery dealers, 602 Main St., Winnipeg, Man. Users of the Vulcan Soot Cleaner in Montreal and vicinity, are experiencing some remarkable results, in every case the saving is great both in labor and fuel. The Standard Shirt Co., Delorimier avenue, Montreal, write that the result of installing their modern system of Soot Cleaners is that they are operating their factory this winter with three of their battery of four boilers, thus increasing their boiler capacity from 15 to 25 per cent.

Quebec

MONTREAL—Laurie & Lamb, Board of Trade Bldg., Montreal, agents for Belliss & Morcom, state that the steam turbine which the latter company designed and introduced a few years ago, is making successful progress. The Birmingham, Eng., corporation electrical supply department have ordered eight 1,000 k.w. Belliss exhaust steam turbines running at 1,500 r.p.m. to work in conjunction with eight Bel-

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The Liberty "Cyclone" Tube Cleaner

The "Liberty" Cyclone Tube Cleaner

is the world's best scale cutting machine. We make Liberty Tube Cleaners in various types and sizes to operate on various weights of scale. They are operated by steam or compressed air as desired. Don't lose coal by operating scaly boilers, use a Liberty Tube Cleaner now and then and save your money.

The "Liberty" COMBINED Tube Cutter and Cleaner

is another of our specialties that should be in every boiler room. With this handy tool a defective tube can be cut out and replaced with amazing speed. And the same tool is used for expanding tubes that leak at their junction with the face plate

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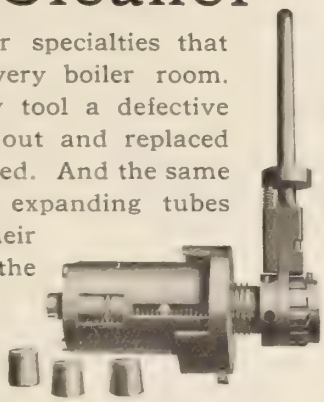

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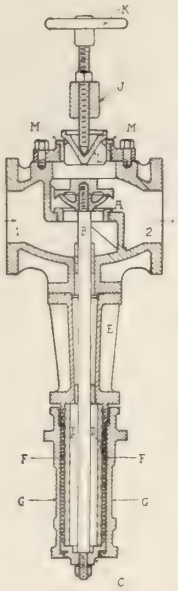

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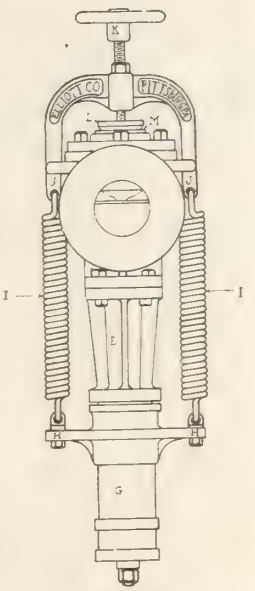

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Joseph Dixon Crucible Co.
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liss reciprocicating engines. These exhaust turbines will run in parallel with the alternating current reciprocating sets in the station making the total of each set 2,500 k.w. on a total capacity of 30,000 k.w.

MONTREAL—George A. Fuller & Co., of New York, the well known building and engineering contractors, have taken offices in the Jacobs Building.

MONTREAL—The Northern Electric & Mfg. Co., with offices in Montreal, Toronto, Winnipeg, Regina, Calgary and Vancouver, have obtained the exclusive agency in Canada for the Safety Armorite Co., Pittsburg manufacturers of the Sterling flexible conduit.

The Sherbrooke council has awarded tenders for the construction of a dam and power house on Magog River to Morrow and Beattie of Peterborough. The price is $51,250.

New Brunswick

ST. JOHN—The Maine & New Brunswick Electric Power Co. are making arrangements to build a power line from their plant at Aroostook Falls to Limestone, Van Buren and St. Leonards, running near Grand Falls. The object is to sell electric power for lights and motors in the towns reached, also to furnish electrical power for the construction work during the establishment of a power plant on the St. John River at Grand Falls, which, it is understood, will soon be built by a company having control of it.

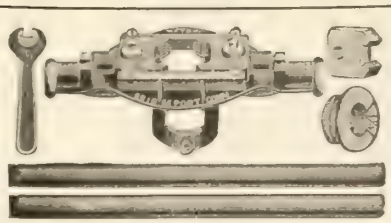
Nova Scotia

SYDNEY.—The Nova Scotia Steel & Coal Co. recently placed an order with the Canadian General Electric Co. for the following 250 volts, direct current, motors: Nine, 25 h.p.; two, 30 h.p.; two 60 h.p.; four 75 h.p.; two 100 h.p., nineteen motors in all, aggregating 900 h.p., to be delivered early in the new year.

SYDNEY.—The P. J. Mitchell Co., London, England, which is engaged upon the construction of an 8000-h.p. electro turbine engine for the Dominion Steel Corporation, recently obtained a contract to build a second one for the corporation, one of 7000 h.p., to operate the new blast furnaces. A steamer is due in February to deliver the completed parts of this second turbine plant.

Needs "The Power House"

Find enclosed order for "The Power House" for 1911. I find it impossible to do without it. —Merrill C. Smith, stationary engineer, M.C.R.



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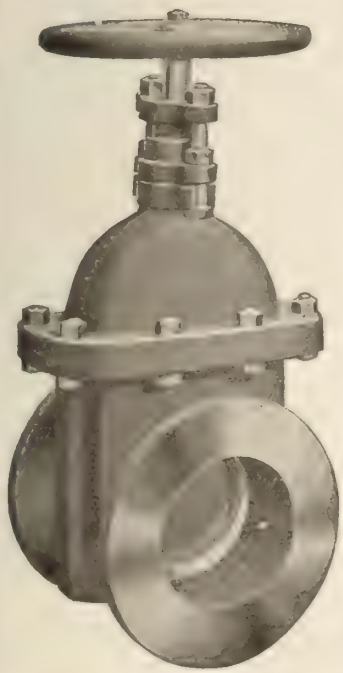

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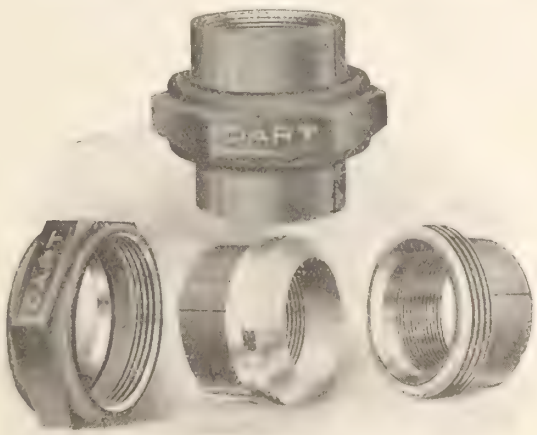

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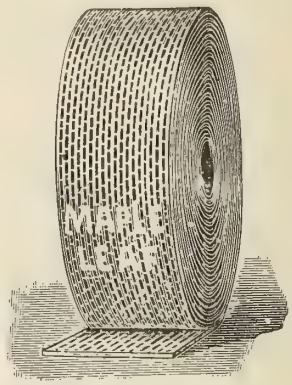

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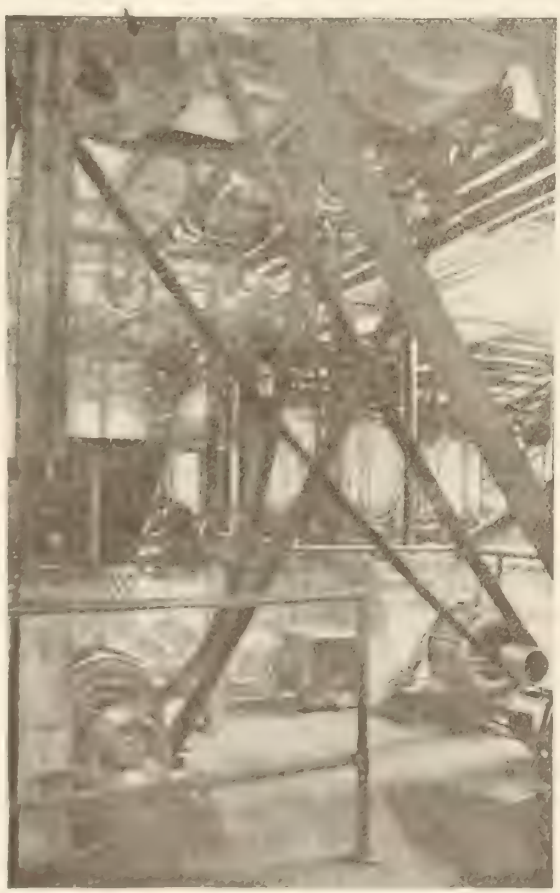

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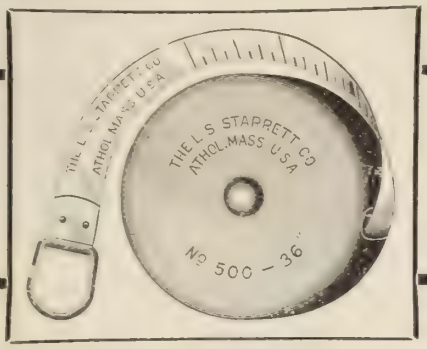

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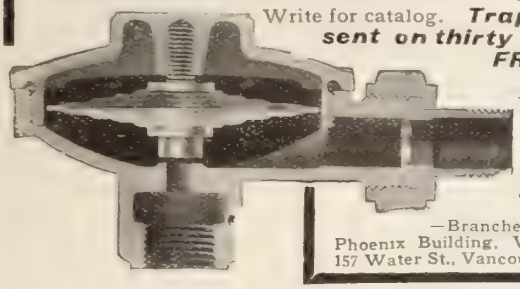

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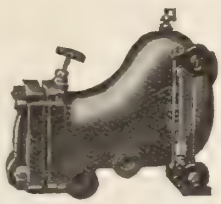

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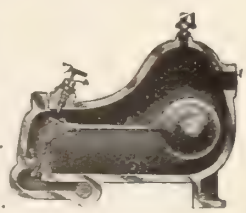

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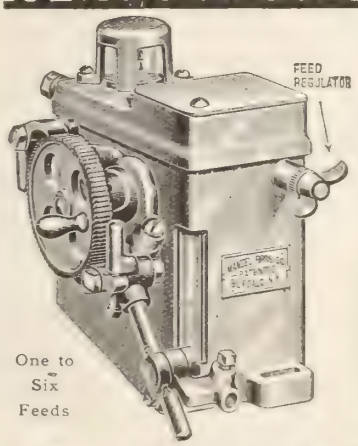

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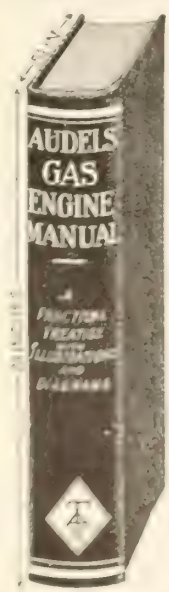

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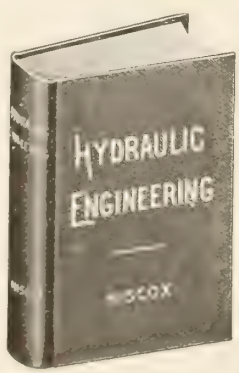

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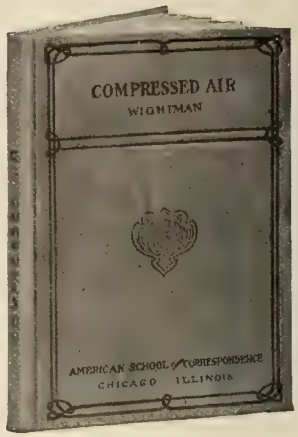

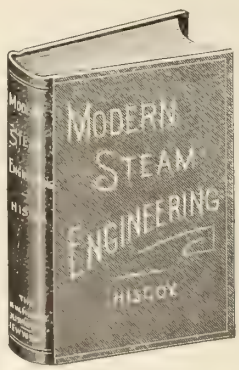

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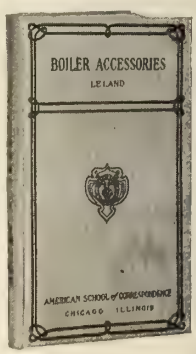

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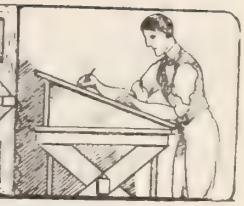

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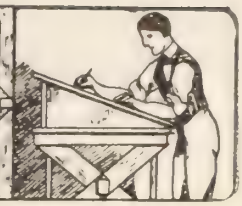

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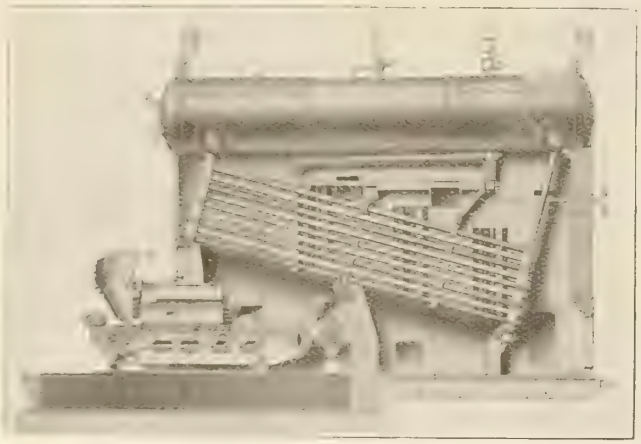

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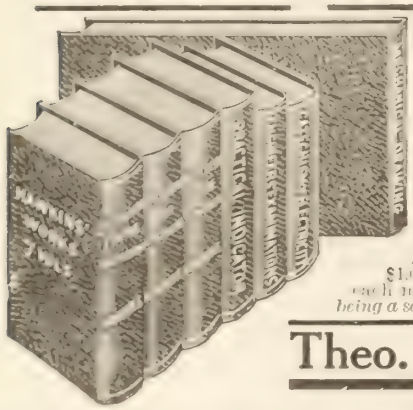

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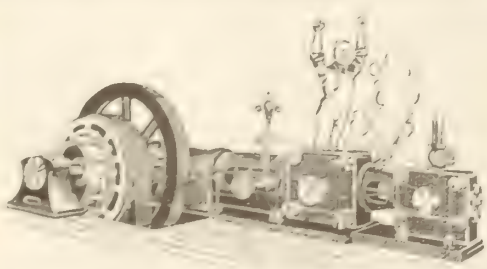

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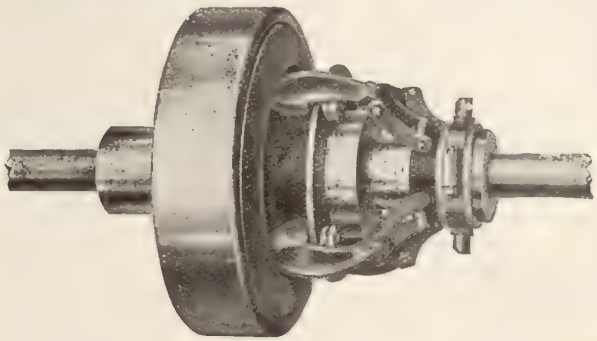

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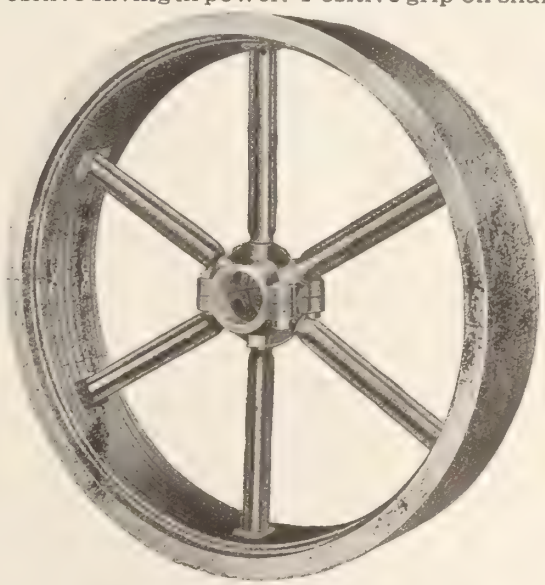

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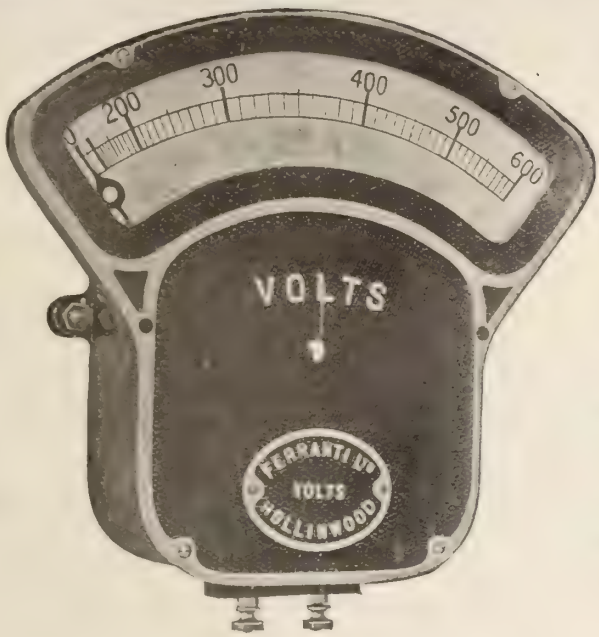

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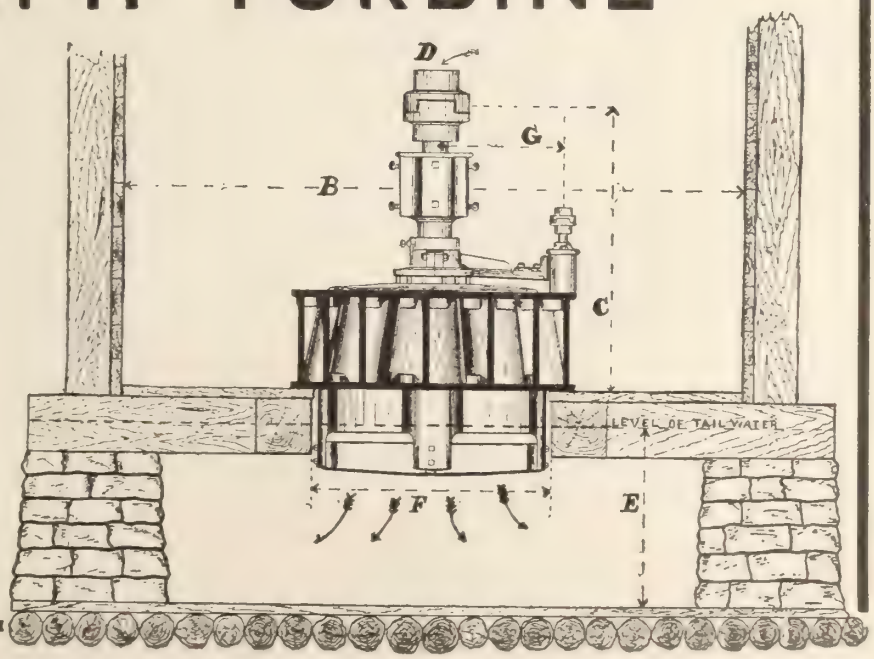

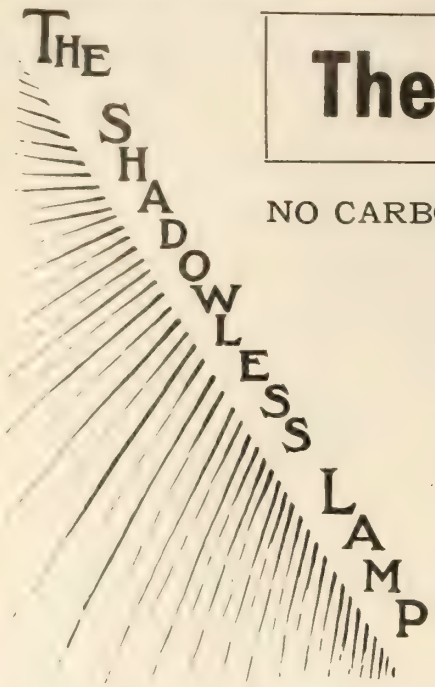

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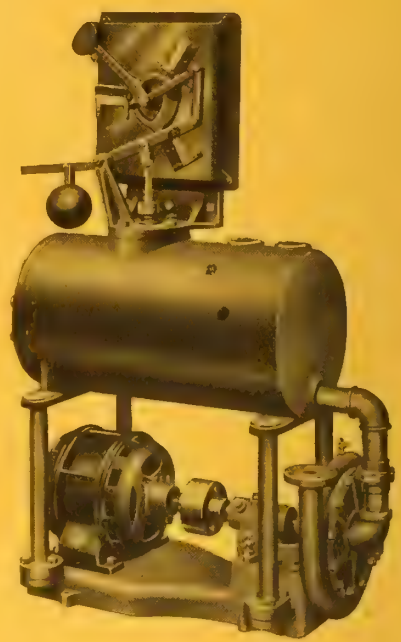
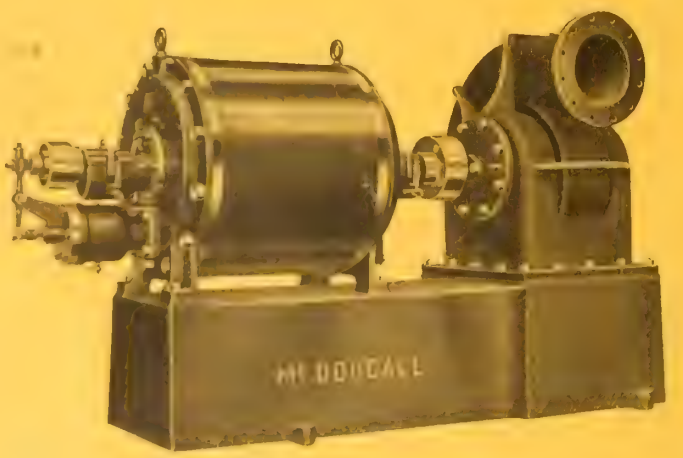
For The Power House

The small Volute pump and receiver, here shown, form a simple and effective means of draining steam jackets, heating systems, steam coils, drying cylinders, etc. The condensed steam is led to the inlet at the top of the receiver and falls to the bottom. The water in rising lifts a float switch and the motor starts and stops the pump automatically. This arrangement obviates the use of steam traps or tanks and, in addition, automatically returns to the boiler all water of condensation.





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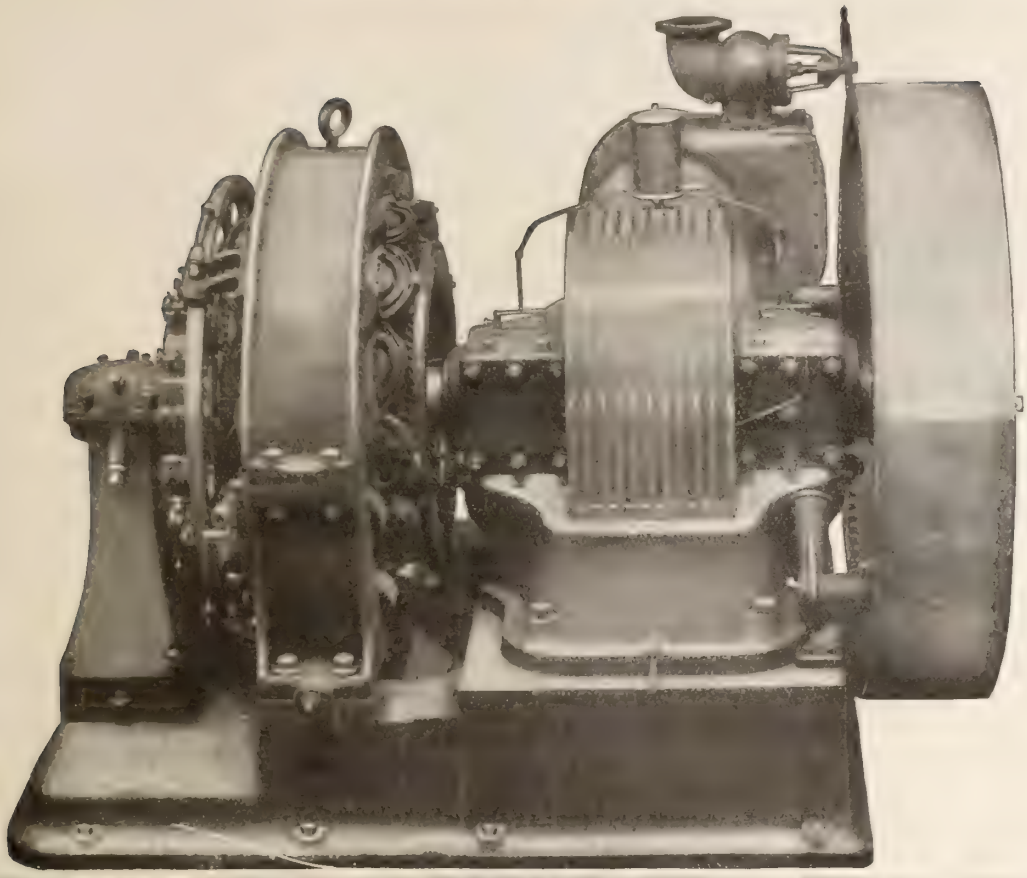

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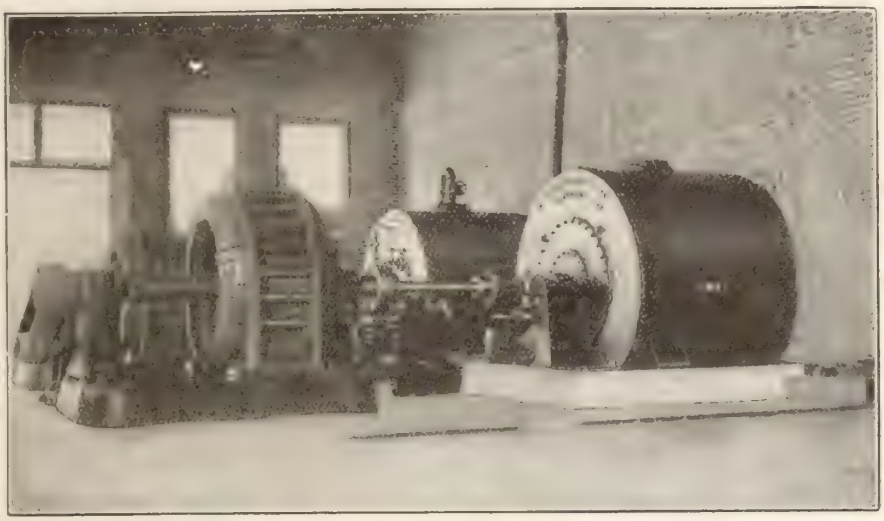

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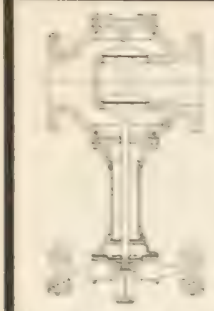
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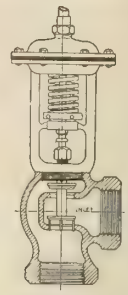
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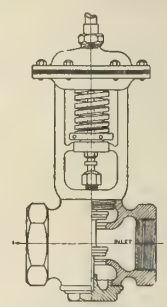
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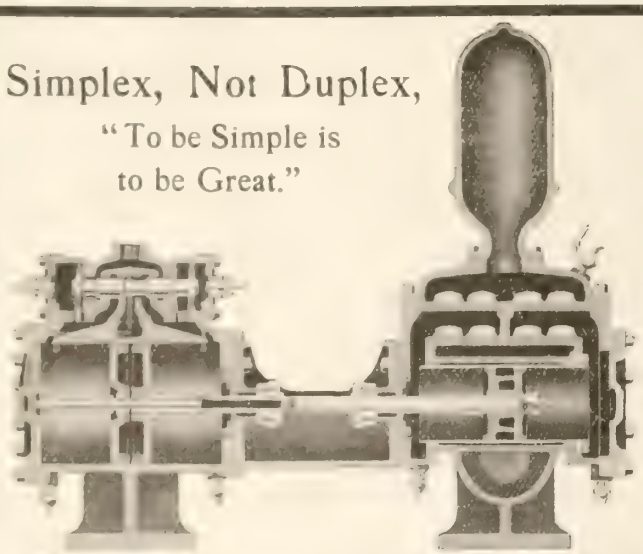
Simplex, Not Duplex,

"To be Simple is
to be Great."



The above cut shows a sectional view of a Marsh boiler feeder. Note the extreme simplicity of construction and few wearing parts. With the exception of the piston itself, the steam valve is the only moving part on the steam end.

American Steam Pump Co.
BATTLE CREEK - - MICH.
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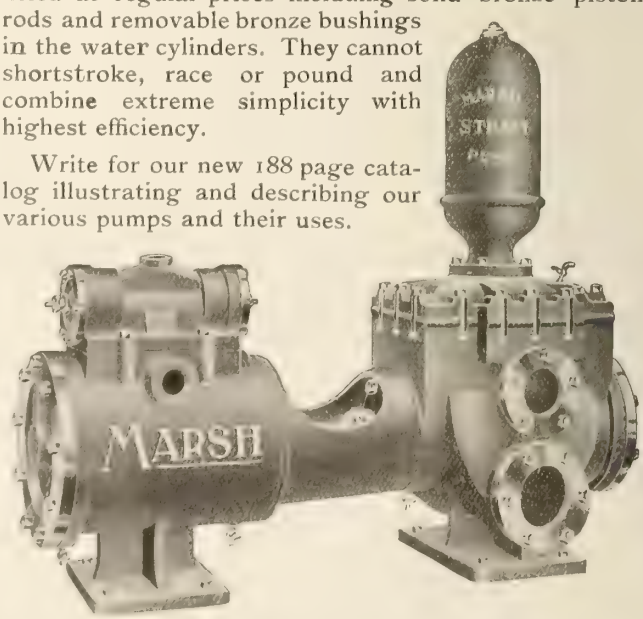
FOR BOILER FEEDING

Built expressly for hard, continuous service.

Marsh Boiler Feed Pumps are thoroughly bronze fitted at regular prices including solid bronze piston rods and removable bronze bushings in the water cylinders. They cannot shortstroke, race or pound and combine extreme simplicity with highest efficiency.

Write for our new 188 page catalog illustrating and describing our various pumps and their uses.



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The full name of these Gaskets is Goetze's Elastic Corrugated Copper Gaskets, with Asbestos Lining, No. 2.

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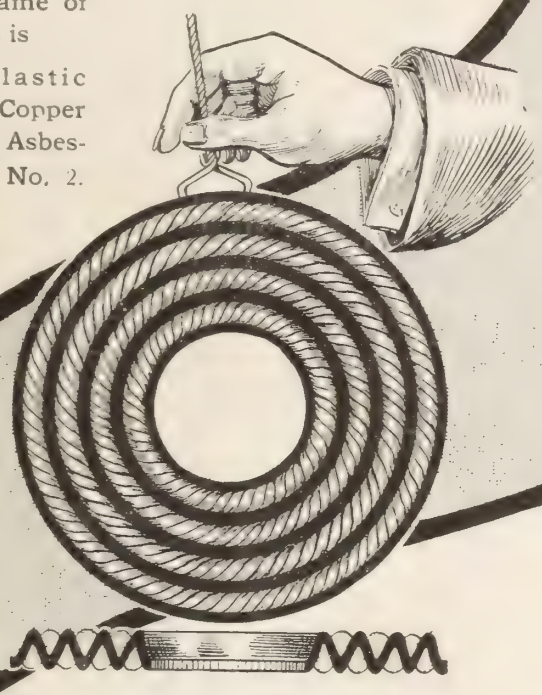

We'll send you a supply of Goetze's No. 2 Gaskets on 90 days' trial at OUR risk.

But you don't have to say, or write, all that in ordering. Save your time by writing simply "Goetze's No. 2 Gaskets" and you will get what you want and get it promptly. Simply give us the sizes you want, and the number of each size, and unless you specify something special," we will ship them within **30 minutes** on receipt of your order.

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On Land or Sea

Wherever water is used in steam boilers

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are necessary to prevent Scale and Corrosion.

"There are many compounds but only one Lord's."

THE REASON IS

Lord's Compounds are made up specially for each case upon carefully prepared analysis of the water in use. Only the best of chemicals are used, prepared by our own chemists and special machinery.

Governments and the largest power plants specify

LORD'S

The kind that has given satisfaction for almost fifty years.

Geo. W. Lord Co.

PHILADELPHIA, PENNA., U.S.A.

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☞ **It is made to order** only after analysis of feed water has been made free by our expert chemists.

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☞ **Red Star** is not only the best, but the **cheapest** boiler compound made—costs you **several cents less** a pound than any other we know of.

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☞ **Every cent** of a purchaser's money will be refunded if Red Star fails to bear out every claim we make for it.

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☞ **It's your move**—send us a gallon of feed water for free analysis.

LAKE ERIE BOILER COMPOUND CO.

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"Boiler Troubles and Their Prevention"

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Bird-Archer Boiler Compounds

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This book goes into details as to our methods—tells *what* Bird-Archer Boiler Compounds do, *why* and *how*.

You can't read it without being benefitted, whether you use Bird-Archer Compounds or not. But if it leads you to send us a gallon of your feed water and give Bird-Archer Compounds a trial (at *our* risk), the investment of your time in reading it will pay you *big dividends* in the higher efficiency of your boilers and a new and larger economy of your own time.

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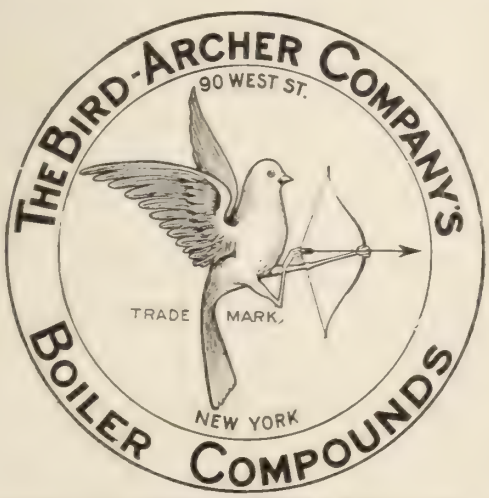

Here's a coupon for your convenience. Fill it in and mail it to us at once and a copy of "Boiler Troubles and Their Prevention" will be sent you by return mail.

THE BIRD-ARCHER COMPANY
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Why Not Have a Scale-Free Boiler ? ? ? ?

THERE is no reason at all why you should permit boiler scale to impede the working of your plant.

And scale always impedes.

Even the thinnest formation means coal waste and lessened steaming capacity.

And the thicker it gets the greater the loss.

Try the Dearborn Treatment

Even if you stop the plant to hammer out the scale before your pump or feed pipe chokes, or your tubes burn out, think of the loss of time and the peck of trouble the best of mechanical tube cleaning means, to say nothing of the damage such harsh methods mean to your boiler.

The Dearborn Treatment is the only way. It means time, money and trouble saved from the very start.

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ROBERT F. CARR, President

General Offices, Laboratory and Works CHICAGO

Eastern Offices, 299 Broadway NEW YORK

DEARBORN TREATMENT DOES IT!

We are as full as a tank with tank talk

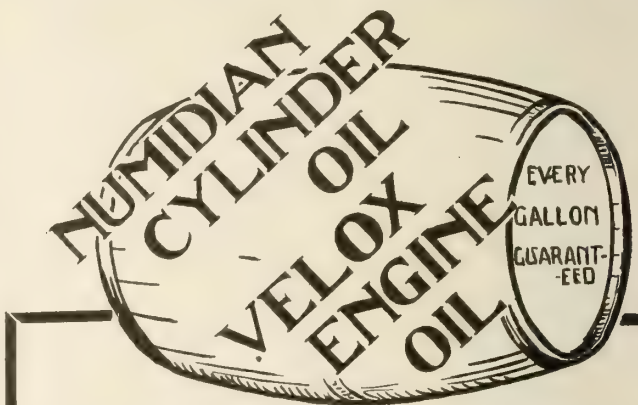
But we know busy men like condensation, so we will content ourselves by stating that

We make Iron and Steel Tanks of all kinds

One of our specialties is an all-welded transformer tank without rivets or seams.

We weld by the new Oxygen-Acetylene welding process.

International Marine Signal Company, Limited, Ottawa Canada



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NUMIDIAN CYLINDER
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They are acknowledged leaders. Freight allowed to destination.

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Oils and Greases of every description.

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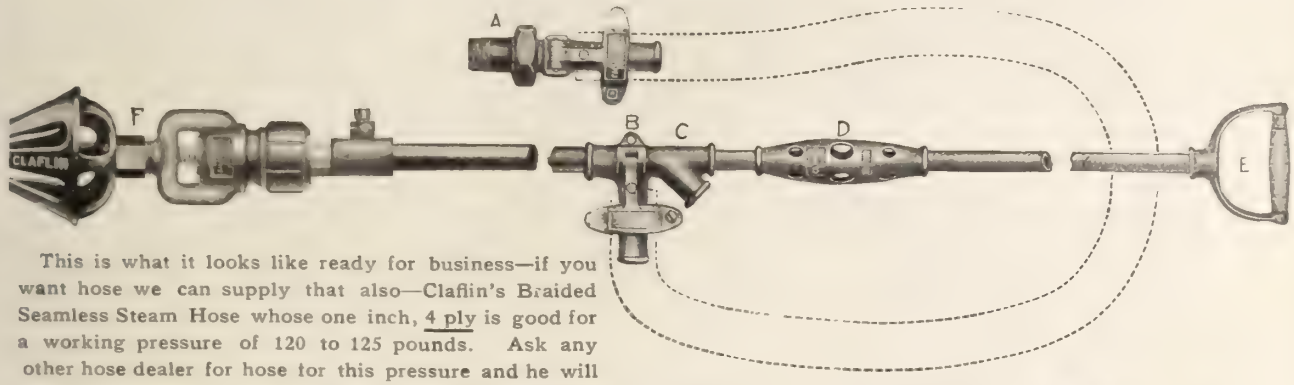
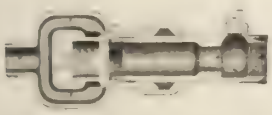
Claflin's Complete Steam Tube Cleaner

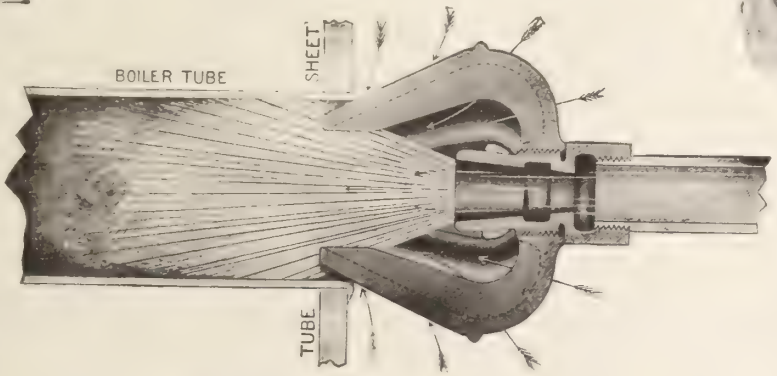
For Taking ALL the Soot from Your Tubes



This is what it looks like ready for business—if you want hose we can supply that also—Claflin's Braided Seamless Steam Hose whose one inch, 4 ply is good for a working pressure of 120 to 125 pounds. Ask any other hose dealer for hose for this pressure and he will say 7 or 8 ply—the difference represents just how much better is CLAFLIN'S HOSE than any other. It is pliable, durable and strong—made for efficient service.



This cut shows the Section of Balanced Valve. Only 3 working parts. Made of best steam metal. Bottles the steam at full boiler pressure right at the end of the tube; a slight push opens the valve which closes automatically when taken from tube. No steam escapes to blow soot back into face of operator and about the boiler room.



"SURE HOLD" Fittings insure you against all scalding accidents. The hose cannot blow off. This feature alone makes the "CLAFLIN" better and safer than any other cleaner on the market.

SECTIONAL VIEW OF
THE BEST CLEANER HEAD AND NOZZLE

That divergent, tapered steam nozzle (steam turbine principle) gives the steam a velocity that is simply terrific, and with the great volume of air which it draws through the Skeleton Head, thus breaking the vacuum, it goes through the tube with a force that sweeps everything before it.

Fill in this Coupon, Mail it to Us To-day and get Our Wide-Open Stringless, Free Trial Proposition

If we can't prove to your absolute satisfaction that the "Claflin" Steam Tube Cleaner does everything we say it does, right down to the last letter in our guarantee, we don't want you to keep it. Anyhow *the trial will not cost you a cent* and you owe it to yourself to fill in that coupon and mail it *now*. The obligation and responsibility are all *ours*. The chance to learn a sure, easy way to save money and labor is all *yours*.

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HALIFAX, N.S.

Send me complete details of the Claflin Steam Tube Cleaner and its component parts.

Name .....

Address .....

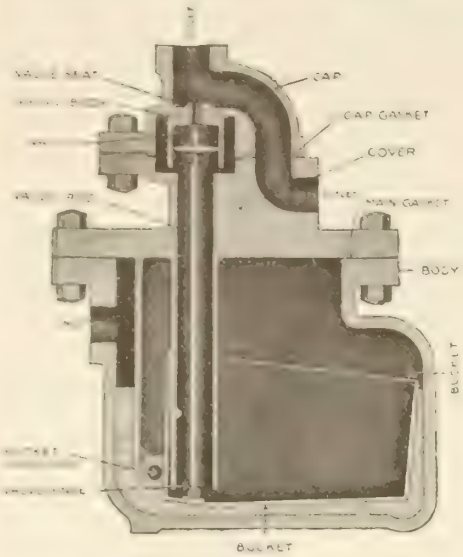
Firm Name of Employer .....

Number of Boilers .....

Type of Boilers .....

Size of Tubes ..... Steam Pressure Carried .....

There are three kinds of Steam Traps—Good, Bad and Indifferent



GOOD traps save your steam.

BAD traps waste steam

INDIFFERENT traps save some of the steam and waste the balance.

You will find

Strong Steam Traps

in the first class. You can find this out for yourself without any possibility of a loss by sending us an order for one or more traps for 60 days' trial. If you don't like them, send them back at our expense, and just remember that on their merits alone we ask your patronage.

Registered 4/S Trade Mark.

The Canadian Fairbanks Co., Limited

Montreal, Quebec, Canada

TORONTO ST. JOHN, N.B. WINNIPEG CALGARY WANCOUVER

The Anderson Improved Steam Trap

Discharges the Water AND Holds the Steam

The Trap That Traps

It is all that its name implies---a trap for steam from which steam **never** escapes, and water of condensation **invariably does.**

The body is constructed of close grained iron, with a valve which can be removed without disconnecting trap from pipes.

The valve and valve seat, of phosphor bronze, are simple in construction and easy of access.

The Anderson will deliver exhaust water against any back pressure of five pounds less than the steam pressure at the trap.

THE V. D. ANDERSON CO.

West 96th Street, Cleveland, Ohio

The advertiser would like to know where you saw his advertisement—tell him.

Quality—Efficiency—Reliability

These, together with reasonable cost, have established the reputation of

Mason Reducing Valves, Pump Pressure and Speed Regulators, Damper Regulators, Balanced Valves.

Reilly Multicoil Feed Water Heaters, Condensers and Evaporators—the most compact and efficient.

It is not what you pay for an article, but what the article pays you in return for its cost, that determines its real value. . . . . .

(Genuine) **Ashton** Pop Valves, Relief Valves, Pressure & Vacuum Gauges, Alarm Gauges.

Berry Safety Automatic Boiler Feed Control - the simplest and best.

France Metallic Packing
SOLD UNDER 3 YEARS' GUARANTEE

Bundy Steam Traps and Separators

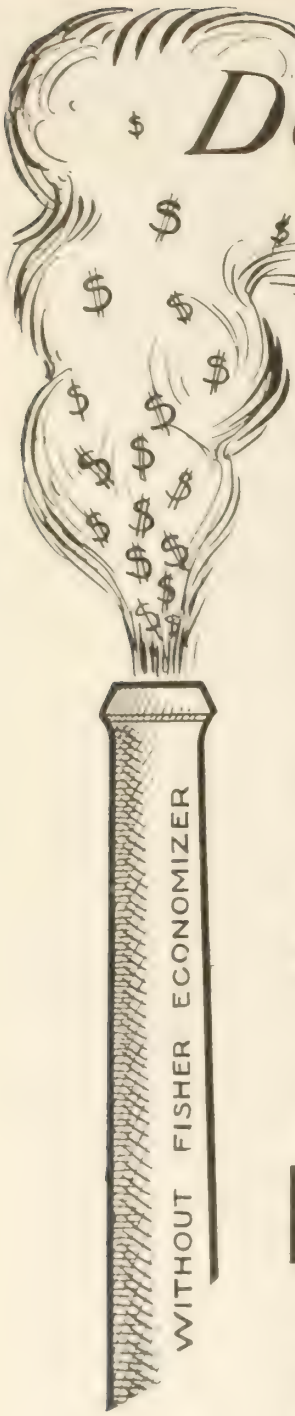
We design complete systems for returning condensation direct to the boilers, and we can effect economies in most steam plants.

Catalogues and full information are at your disposal.

H. L. PEILER & CO., 52 St. James Street, MONTREAL
404 McKinnon Bldg., TORONTO

100% STEAM TRAP EFFICIENCY
¶ MOREHEAD STEAM TRAPS operate on a principle that insures the complete saving of the heat units represented in the condensation from the steam line returns.
¶ The condensation from any steam heating or power apparatus must be removed. The quicker the condensation is removed, the dryer and more effective will be the steam lines. The condensation is pure water and HOT: it is the greatest extravagance to waste it.
¶ The most effective way to utilize the heat content is to deliver it into the boiler before it vaporizes. In no other manner can the condensation be handled so quickly and with the same economy as with a Morehead Trap.
¶ All about it in the "Trap Book." Write.
MOREHEAD MFG. COMPANY
DETROIT, MICHIGAN.
¶ This illustration shows one of eight Morehead Steam Traps installed at the plant of the McKeesport Tin Plate Company, McKeesport, Pa.

Dont let your money go up in smoke



THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?
¶ About 6 per cent.; the rest is wasted.
¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?
¶ Not over 10 per cent.; often less.
¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.
¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.
¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.
¶ This should be easily done.
¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.
¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.
¶ We save money for the factory owner and railway.
¶ We save the fireman much hard and dirty work.
¶ We save the black smoke which pollutes the air.
¶ We reduce your ashes and clinkers half.
¶ We increase and maintain steam to a degree which is impossible without the economizer.
¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

MONTREAL
Gerald Rowe, 187 McGill Street
Phone Main 511

OTTAWA
569 O'Connor Street
Phone 4194

WINNIPEG
310 McGreevy Block
Phone Main 2750

The advertiser would like to know where you saw his advertisement—tell him.

"THE Cyclone"

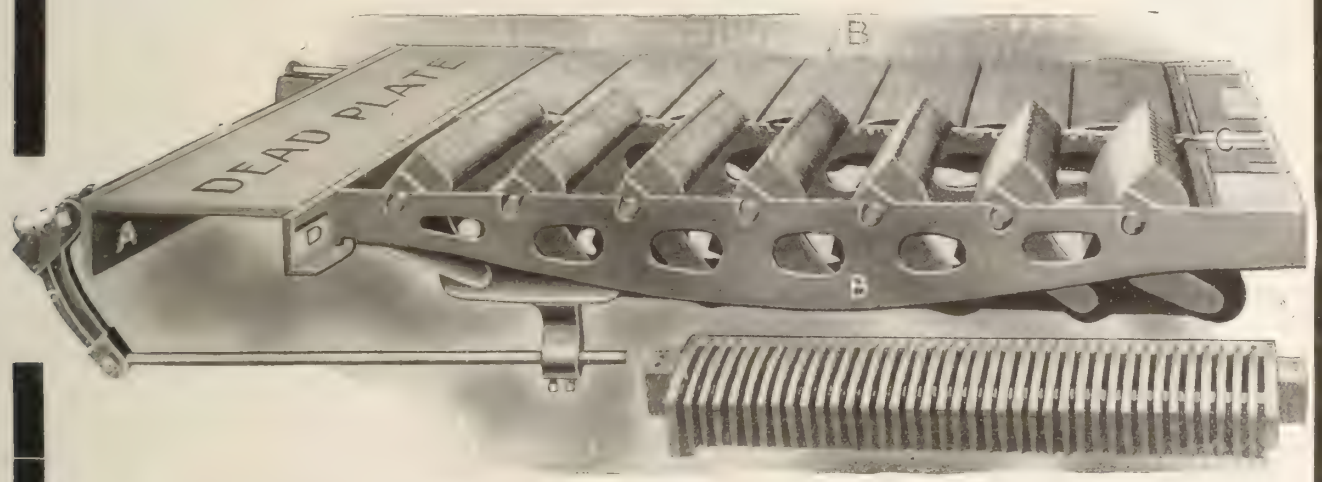
Shaking and Dumping Grate Bar

This is the Grate Bar which will generate more steam from the amount of fuel consumed than any other grate in the world. It is the only grate from which you can obtain the maximum results from such cheap fuel as soft and hard coal screenings, hard or run-of-mine coal, etc.

The reason is not far to seek. The construction of the "Cyclone" Grate Bar allows 68% of air space, and 90% under draught

And its greatly improved shaking mechanism effectively keeps the bars quite free from clinkers and prevents any waste of fuel,

The "Cyclone" locks level, cannot get out of order and never warps.



Read the accompanying letter---one of hundreds received from appreciative business men, and be convinced of the superiority and economy of the "Cyclone."

WRITE TO-DAY FOR OUR ILLUSTRATED CIRCULAR.

CANADIAN BOILER EQUIPMENT CO. TORONTO

GENTLEMEN:

We are sending you to-night, through our Head Office in Montreal, an order for another set of Cyclone Shaking and Dumping Grate Bars for one of our boilers. We are glad to say that wehave no reason whatever to regret the installation of thefirst set of these bars Wehave had them in operation several months, and we find that we get more perfect combustion and much better fires and greater economy in our use of coal with these bars than we have had from any system of firing that we have tried at this mill. It is our intention, during the coming summer months, to complete the installation of these grate bars under our other four boilers

Yours truly,

The Canadian Colored Cotton Mills Co., Ltd., St Croix Mill

J. W GRAHAM, Manager

Canadian Steam Boiler Equipment Co., Limited

(Sole Manufacturers for Canada)

186 Queen Street East, Toronto

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WINNIPEG—VULCAN IRON WORKS, LTD.

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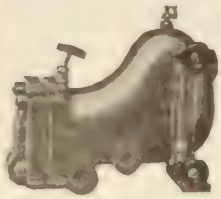


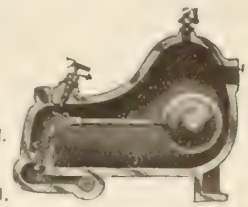
McDANIEL IMPROVED **STEAM TRAP**

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, CAN.

The DUNHAM RADIATOR TRAP

for simplicity, capacity and reliability has no equal. Only one working part—nothing to get out of repair. Guaranteed to pass air as freely as water without the loss of steam. The ONLY TRAP THAT DOES IT. Ask for catalog "B."

C.A. Dunham CO., Limited
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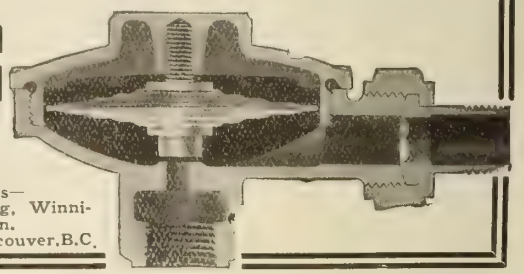

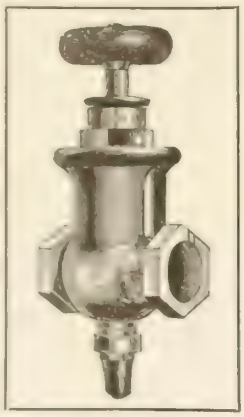

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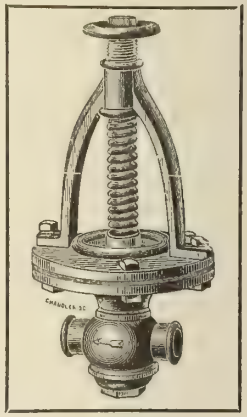
On Your Engineering Specialties

It is your protection against poor goods and poor service
See that you get it.

Balanced Steam Trap
Return Steam Trap
Expansion Trap
Separator
Damper Regulator
Temperature Regulator
Improved Pressure Regulator
Tank Governor and Pump

These and other specialties described in our catalogue.
Write for a copy,

Julian d'Este Company
24 Canal Street : BOSTON, MASS.



ONCE IN, IT WORKS FOREVER

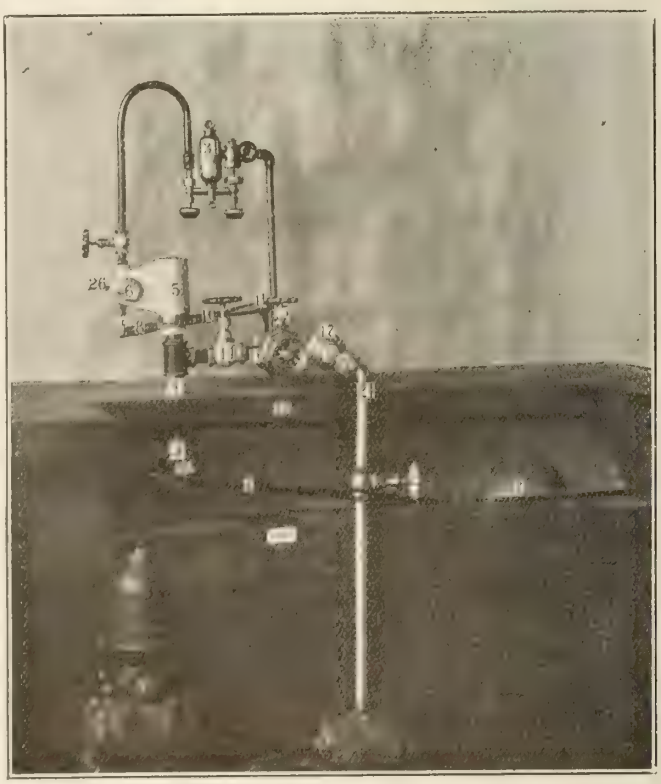
The beauty of installing a Bice Regulator is that you can immediately forget all about the problem of keeping the water in your boiler at the right level.

The Bice Regulator

does it automatically. It regulates one boiler or any number of boilers, maintaining a constant, uniform supply of water in each boiler, under all conditions. It is a self-contained Brass Casting, simple in design, easily attached to any kind of steam boiler, whether used for power or heating purposes. Does away with the pump governor on Single Boilers. Requires on attention whatever. There are more than

Thirty Real Reasons

why every engineer should be acquainted with the Bice Regulator. Our free booklet tells all about it and a copy is waiting here for YOU. Write us for it.



The Bice Regulator Co., Ltd.
2 Green & Swift Bldg. : LONDON, ONT.

Agents for Ontario---The Asbestos & Rubber Goods Co., 141 King Street East, Toronto

Agent for Quebec---E. F. Owen, Room 1008 E. T. Bank Building, Montreal.

A Safeguard for your Boiler Room

There is a constant feeling of security whenever your boiler room is protected by a

RELIANCE SAFETY WATER COLUMN

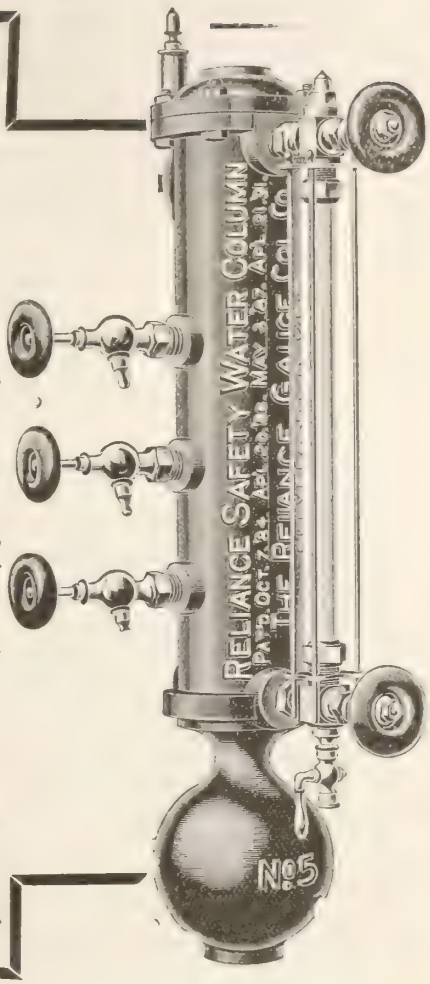
A safeguard that is reliable, permanent, never failing, never tiring and never absent.

It makes changing water level impossible, reduces fuel waste, and assures dry steam at all times for the engine.

If water runs high or low instant alarm is given. The RELIANCE will reduce the number of leaky tubes, and prevent danger of boiler explosion due to low water.

For steady power, combined with boiler safety, you must see that RELIANCE Safety Water Columns are on your boilers.

WRITE FOR CATALOGUE.

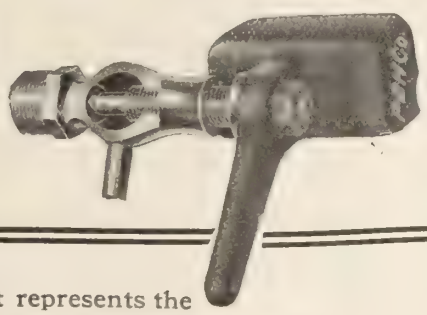


The Reliance Gauge Column Co.,

5902 Carnegie Ave., - CLEVELAND, OHIO.

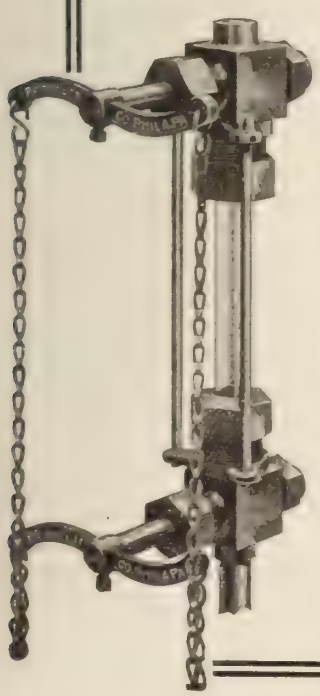
Also Manufacturers of Reliance Steam Traps, Lever Water Gauges, Lever Gauge Cocks.

TROUBLE BANISHED from your Boiler Room



By Using These Well-known

"P. B. H." Specialties.



Cut on left represents the

"P. B. H." Quick Closing Water Gauge

the best known insurance against scalds and burns. When glass breaks a pull of the chain shuts off both water and steam instantly. Made extra heavy of best steam metal.

SENT ON TRIAL.

Cut above is our

"P. B. H." Quick Opening, Self-Closing Weight Gauge Cock

simple, efficient, economical and easily repaired if necessary Guaranteed free from leaking for one year.

Cut on right is that of the

"Tornado" Steam Boiler Tube Cleaner

a cleaner that works better, more economically and more quickly than any other. Blows out effectively the longest tubes because air injected causes no moisture.

Get full details of our many labour saving and safety devices.

THE PAUL B. HUYETTE CO., Incorporated

1414 Betz Building, PHILADELPHIA, Pa. U.S.A.

Write for Catalogue

Selling Agents for Western Ontario and North-West: Canadian Steam Boiler Equipment Co. 186 Queen E., Toronto.

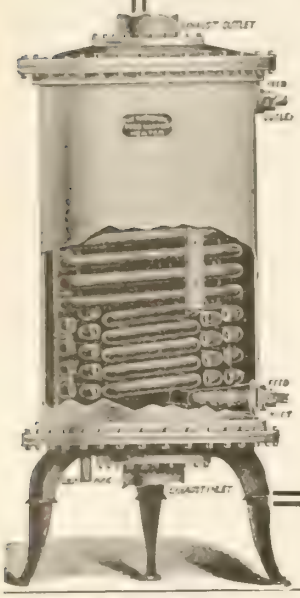
Selling Agents for Province of Quebec and Eastern Ontario: H. L. Peiler & Co, St. James St., Montreal, Canada.

Selling Agents for Maritime Province and Newfoundland: H. L Peiler & Co., Moncton, N. B.

Practical—Simple—Efficient

You can save fuel and heat your feed water to the boiling point with your waste steam if you are using the

NATIONAL
Feed Water Heater



And the cost of installing the "National" is trifling, compared with the economy it means to every steam user.

The "National" consists of 1 to 14 coils of seamless drawn brass or copper tubing encased in a cast iron or steel shell, No inside tubes to leak, no leaky straight tubes, no back pressure, and no contact of the water with the shell or iron.

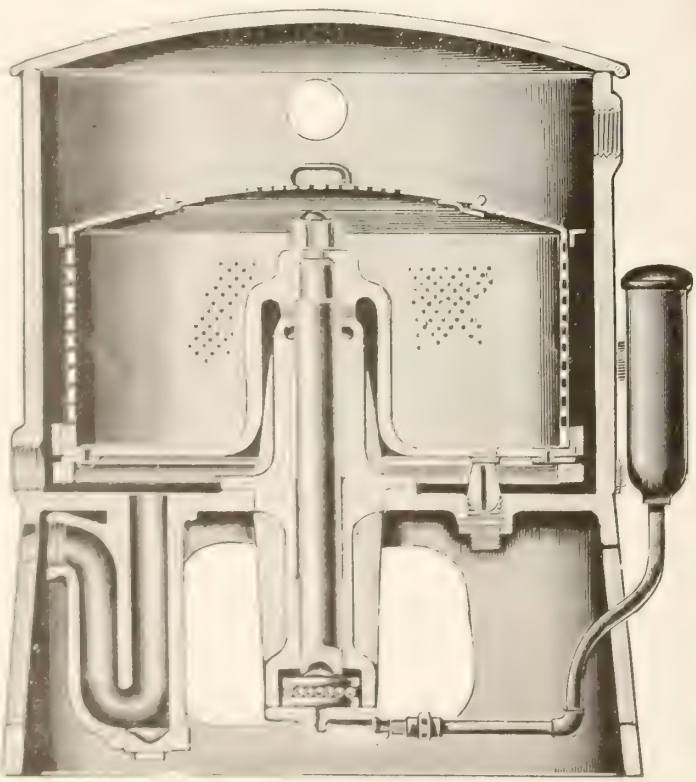
BETTER INVESTIGATE OUR CLAIM—IT WILL PAY YOU WELL

Ask for our Free booklet on feed water heating

The National Pipe Bending Co.

91 Lloyd Street, New Haven, Conn.

IMPROVED WASTE MACHINE
WITH
WASHING ATTACHMENT

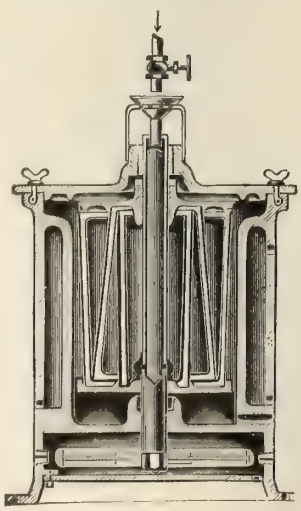


ECONOMIZE
Save Oil—Save Waste

We Manufacture
OIL and WASTE MACHINES, CHIP MACHINES, TURBINE CENTRIFUGAL OIL FILTERS, and CENTRIFUGAL EMULSION MACHINES

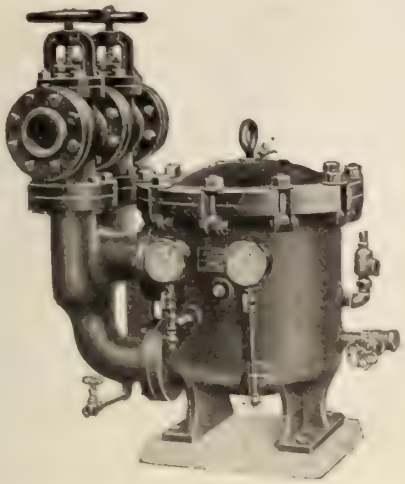
We have machines with—The E. B. Eddy Co., Ltd.; Grand Trunk Railway; Can. Pac. Ry.; Dominion Coal Co.; J. R. Booth; Toronto Water Works; T. Eaton Co.; Montreal Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oat Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co.; Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.; Consolidated Mining & Smelting Co.; Montreal Cotton Co.; Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd.; J. & P. Coates, Ltd., and many others.

TURBINE CENTRIFUGAL OIL FILTER



ASK FOR CATALOGUE

The CANADIAN OIL and WASTE SAVING MACHINE CO.,
LIMITED
Brockville, Ontario.



Blackburn-Smith Filters Keep Oil Out of Boilers of Pittsburg Water Works

The Bureau of Water, City of Pittsburg, has long been convinced that filtration through layers of linen terry cloth is a most practical method of eliminating oil from boiler water. To prove the value of this filtering medium, four 2,000 H.P. Blackburn-Smith Feed Water Filters and Grease Extractors were installed in the Brilliant Pumping Station and the results carefully observed. These four filters went into service in September last year. On the strength o f their performance the Bureau of Water has now ordered four more Blackburn-Smith Filters of the same size for the Brilliant Station, and two 4500 H.P. Filters for the Ross Pumping Station at Aspinwall.

Blackburn-Smith Filters have frequently been endorsed by repeat orders from large power users. The reason is plain. No other filtering medium is so good as linen terry, and no other arrangement of the terry is so good as in these filters. The entering water gets a *double* filtration through *separated* cloths, while at the same time the construction permits thorough cleaning of the filter in five minutes.

Don't throw away valuable heat and water because your open heaters, line separators, sand and charcoal beds, etc., will not retard all the oil in condensation. Put one of these filters into the feed line and if a 60-day trial does not stop the trouble to your entire satisfaction, send the filter back.

Ask for Booklet, "Feed Water Filtration."

Canadian Sales Agents

Eadie-Douglas, Ltd.

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The "OTIS"

Tubular Feed Water Heater, Oil Separator and Purifier

Besides utilizing your exhaust steam to heat your feed water to the boiling point, extracts all oil from the exhaust. This enables the steam to be used for further heating purposes and effectively cuts down your fuel bills.

CATALOGUE AND FULL DETAILS FOR THE ASKING.

Write us to-day

The Stewart Heater Co.

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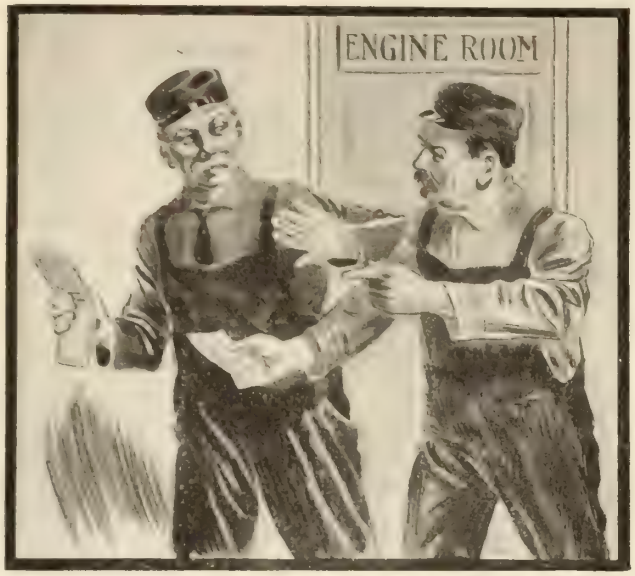

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"Special"

If you owned one of these books of "Questions and Answers to Engineers' License Examinations," you, like many other engineers, would say: "No money would buy this book"—if you couldn't get another copy. And, yet, you may have the book ABSOLUTELY FREE, if you go to your dealer's and simply *look* at

DANIELS' P.P.P. ROD PACKING

This Packing automatically adjusts the pressure on the rod to the requirement, whether it be 300 lbs. or but 5 lbs. P.P.P. saves the engineer work and the employer money.

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If your dealer doesn't carry P.P.P., we will write, telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

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GARLOCK

Packing Prestige

Is the result of scientific compounding and manufacturing for over thirty-five years.

Works at Hamilton, Canada.

Packings in

LOW and HIGH PRESSURES

For STEAM, HOT and COLD WATER,

AMMONIA, AIR, GAS and LIQUIDS

The GARLOCK stands for significant merit and exceptional stability.

The Garlock Packing Co.

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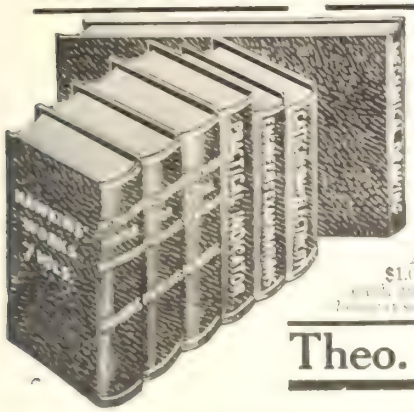

Every Engineer, Superintendent, Machinist, Electrician, Fireman, User should have the work known as "Hawkins' Works" for ready and ready reference. The seven books shown in illustration are the most complete and helpful works published for the practical man, convenient in size, and well bound, containing 2,268 pages, 5,171 ready references on engineering [illegible] questions and answers, 444 standard rules, 1,258 illustrations and diagrams, making them a [illegible] and [illegible] at small cost. Small [illegible] payments as shown below.

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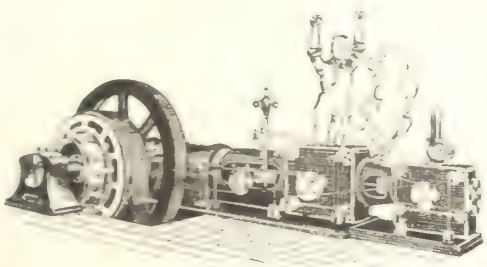

ARE YOU HAVING THIS TROUBLE?

IF SO, PACK WITH

Rhodes Metallic Packing

We will warrant you have no more trouble for at least one year.
It is a packing which you instal and forget.

AGENTS WANTED

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

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"PREMDURO" *The IDEAL PACKING*

has "cut out" all the kicks so common with users of rubber canvas, metallic and asbestos soft packings.

"PREMDURO" is composed of numerous triangular soft metal wires of special composition, and the packing readily shapes itself to either a scored or smooth surface.

Simple to insert and costs less than any other efficient metal packing.

"PREMDURO" contains no rubber, asbestos or other material that scored rods or high pressures can affect, and is at once durable, non-heating, non-scoring and self-lubricating.

Try "PREMDURO" yourself. Give it a thorough test, and if it won't do all we claim for it we will cheerfully refund any money you have invested.

Write for samples, literature and prices.

Premier Engineering & Mfg. Company

25 Broad Street, New York

Don't fail to mention this paper in writing to advertisers.

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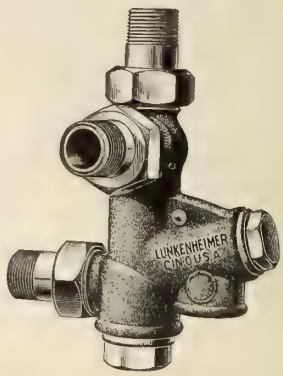
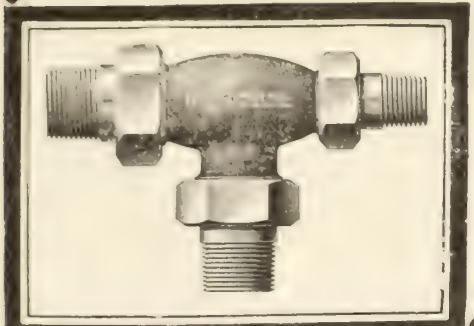
EXCEL THOSE OF ANY OTHER KNOWN MAKE. THEY WILL DELIVER MORE WATER PER POUND OF STEAM THAN ANY OTHER. WHICH MEANS A SAVING IN FUEL, AND THE MAXIMUM CAPACITY CAN BE GRADED OVER 50 PER CENT.



LUNKENHEIMER AUTOMATIC INJECTORS

WILL LIFT WATER QUITE A HEIGHT, TAKE VERY HOT WATER AND WILL FORCE AGAINST A MUCH GREATER PRESSURE THAN THAT OF THE BOILER. THEY ARE MADE IN FIVE TYPES TO FACILITATE CONNECTING.

YOUR LOCAL DEALER SHOULD HAVE THEM. IF NOT WRITE US.



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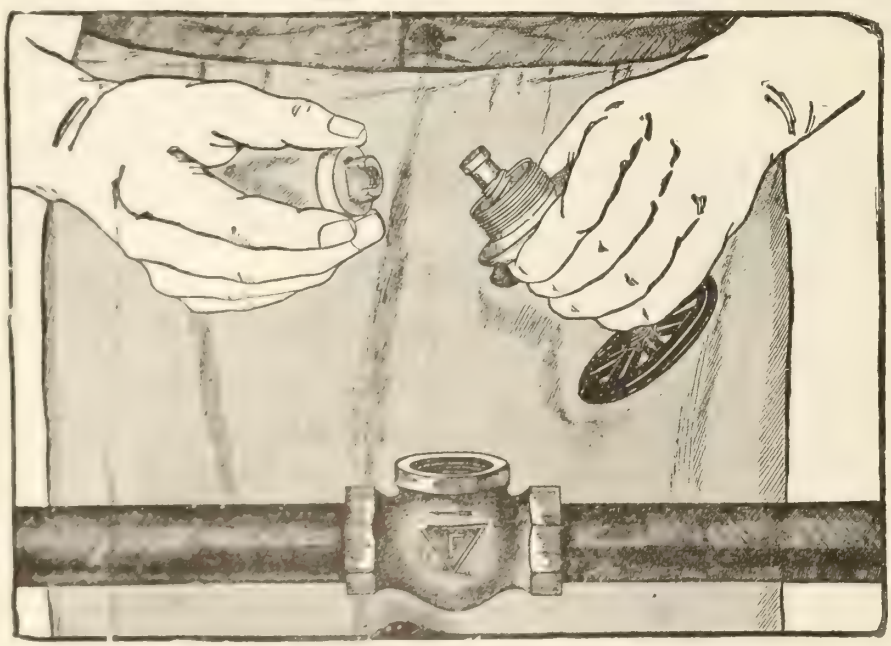
A Tight Joint

IS AN ESSENTIAL THING IN ANY POWER HOUSE



Fairbanks Renewable Disc VALVES

are tight under the most severe service. The reason for this is, that the wear comes on the composition ring in the disc, and by replacing the disc at slight cost the valve is made as good as new.

The Canadian Fairbanks Co., Limited

Fairbanks Scales---Fairbauks-Morse Gas Engines---Safes and Vaults.

MONTREAL TORONTO ST. JOHN, N.B. WINNIPEG CALGARY SASKATOON VANCOUVER

Type "K"

Iron Body

Tested to 300 pounds hydraulic pressure.

Elliptical in design.

Double compensating bronze-faced discs.

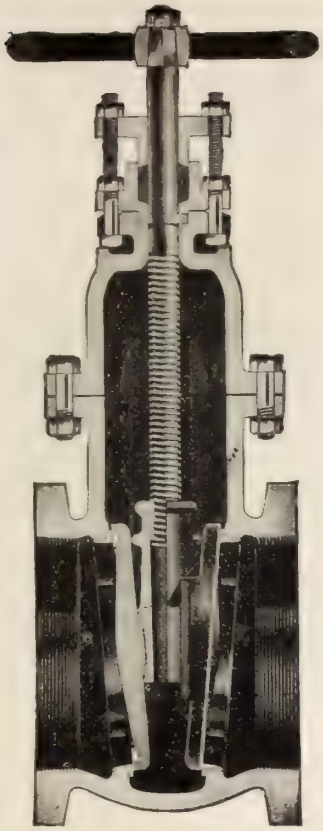
Can be re-packed while under pressure and wide open or closed.

Parts interchangeable.

Discs cannot jam.

Possess wide margin of safety.

Stocked by jobbers and dealers everywhere



Gate Valves

Bronze Mounted

Suitable for 125 pounds working steam pressure.

Design insures great rigidity and strength.

Heavy bronze seat-rings screwed into body and renewable.

Bronze disc-rings forced into double grooved recesses in discs.

Can be operated in any position.

Handsome appearance.

Dependable in service.

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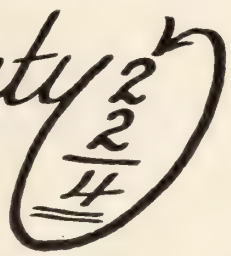
JENKINS BROS., Limited, Sole Manufacturers

103 St. Remi Street - - - MONTREAL

An Absolute Certainty



It is as certain as is 2 plus 2 equals four that any joint made with a Dart Union will never leak.

Dart Unions Cannot Leak

They are made in two sections, each of which is seated with smoothly-ground, rustless, non-corroding bronze.

The two sections meet in the form of a ball joint that can be made with amazing speed even when pipes are out of alignment.

You will forget what a leaky joint looks like when you are using nothing but Dart Unions for making pipe joints.

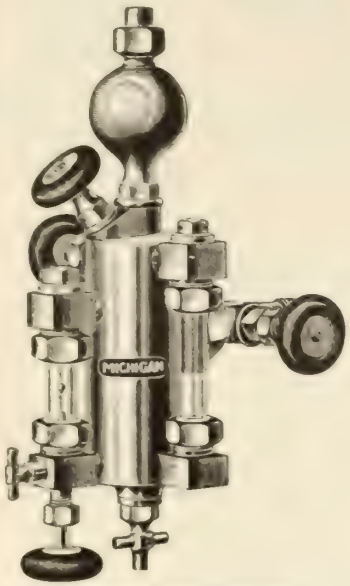
Put a Dart Union on the meanest place in the shop and note results.

Your dealer sells them.

Dart Union Co., Limited

TORONTO CANADA

MICHIGAN



Improved Double Connection

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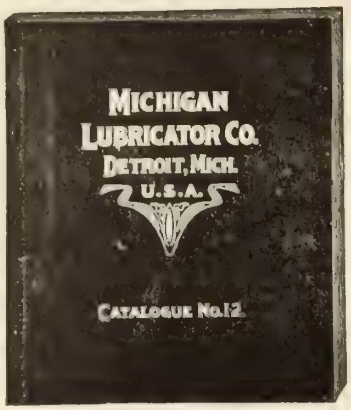
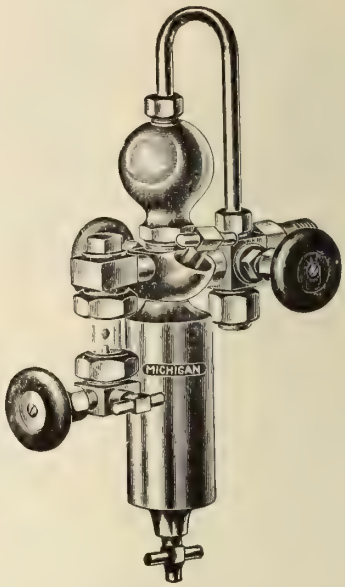


WRITE TO-DAY



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Detroit Lubricators are a quality product.

Because of their quality, Detroit Lubricators are the world's standard of excellence.

One and a quarter millions of Detroit Lubricators are giving satisfaction to-day wherever lubricators are used.

And wherever a Detroit Lubricator has been used, the name Detroit has come to mean quality.

Quality has made Detroit Lubricators the standard for over thirty-three years.

Imitators have made lubricators that look like Detroits, but they haven't imitated Detroit quality.

They might, perhaps, if they had the long experience, skilled knowledge, great organization and wonderful plant that is behind Detroit Lubricators—but they haven't.

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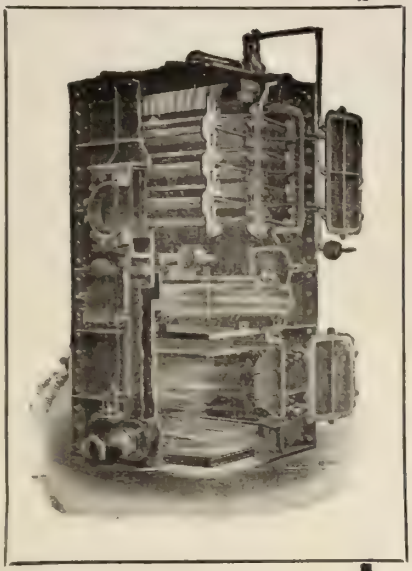
Write to-day for Catalog A58 and full information.

DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

Largest manufacturers of lubricating devices in the world.

More Power at Less Cost !



Here's a proposition to diminish working costs that must surely appeal to YOU!

Will you investigate the merits of the

WEBSTER

Feedwater Heater, Purifier and Filter?

It makes use of all condensations and waste steam, and will positively rid your boiler of scale by removing all scale-forming elements from your feedwater. Using pure water means getting every ounce of power out of your boiler with a *smaller* amount of fuel.

Our descriptive literature has many points of interest for you! Send for it TO-DAY.

DARLING BROS., LIMITED

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Hand Cylinder Oil Pump. Reversible Shank

We are the largest manufacturers in the country making a strictly high grade line of lubricators and other equipment for Engines and Boilers.

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Dialed Indicator Valve for Gas Engines. Size ¼ to 4 inches

Let us have your enquiries.

No trouble to answer letters.

Catalog on request.

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Detroit, Mich., U.S.A.

SAVES

33 1/3 % to 50 %

over any other

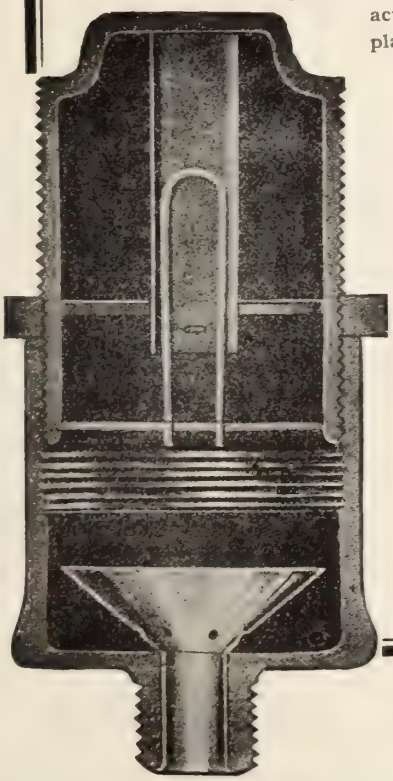
System of Lubricating

The only automatic grease cup on the market in which compressed air is the feeding force is the

"PHILADELPHIA"

Grease Cup

and because compressed air is used, the *pressure is always uniform* to the last drop of grease!



The "Philadelphia" is equally positive in action in whatever position placed, and it is not affected by centrifugal force when used on loose pulleys, etc.

The "Philadelphia" saves time and labor, requires no attention, increases efficiency, decreases expense, and is absolutely dust-proof.

Has been thoroughly "tried out" and invariably returned a "winner."

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Peterborough Lubricator Mfg. Co., Limited

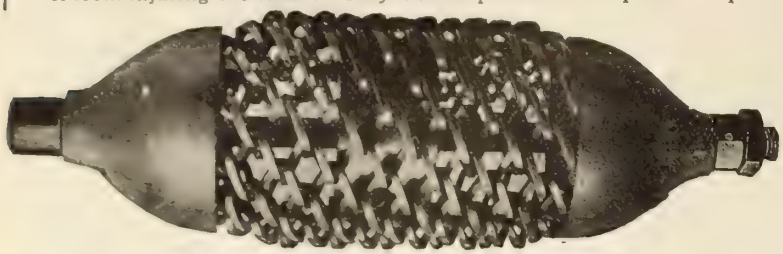
Peterborough Ontario

KEEP YOUR BOILERS CLEAN BY USING THE

Criss-Cross Boiler Tube Cleaner

It means a saving of from 10 to 15 per cent. of your fuel and a better working boiler.

The Criss-Cross Cleaner is made of high carbon wire with a large number of independent, oblique cleaning edges. It cuts the scale without hammering and without the least injury to the tubes. Its double conical shape and the spring of the wire prevent it from injuring the tubes. Only a small pressure is required to operate it.



This is the cheapest, most effective and most durable tube cleaner on the market.

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Worcester Brush & Scraper Co.
WORCESTER, MASS., U.S.A.

For sale by the largest mill supply houses throughout Canada and all foreign countries.

MADE IN CANADA

GAS ENGINES OF ALL KINDS, FOR ALL PURPOSES, EITHER VERTICAL OR HORIZONTAL TYPES.

Power users can have cheap power under their own control by use of either

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The Canada Producer & Gas Engine Co., Limited

S. DYMENT, President. BARRIE, ONT., CANADA WM. THOMPSON, Managing Director.

It's up to you ENGINEERS, if you would insure your continued reputation, to specify a grade of BABBITT METAL that for years has been giving the best of satisfaction.

HERE IS THAT LINE

The Canada Metal Co.'s IMPERIAL GENUINE is the one grade of BABBITT METAL that you can be absolutely sure will prove the soundness of your judgment when you specify.

Manufactured and Guaranteed by

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The low co-efficient of friction and anti-frictional and wearing qualities that have made Magnolia Metal the greatest of all Babbitt metals for lining bearings make it equally valuable as a Metallic Packing. If you have not heretofore thought of Magnolia Metal in that connection, we trust that you will not fail to do so in future.

Department of Commerce and Labor
STEAMBOAT INSPECTION SERVICE

OFFICE OF LOCAL INSPECTORS
JUNEAU, ALASKA

October 19, 1910.

Magnolia Metal Company.
113-115 Bank Street.
New York City, N.Y.

Gentlemen:

Before entering this Service I was employed by the Puget Sound Tug Boat Co. of Seattle, Wash. as Chief Engineer of their Ocean Tug "TATOOSH", this vessel being equipped with a triple expansion engine 16" 24" & 40" by 28" stroke, with all piston rods and valve stems packed with the "Metalic Packings." At first we used as "packing metal" a hard fine grained babbitt composition, sold on the Pacific Coast under the name of "Packing Metal" the soft rings being cast, and machined in the shop, then scraped to place by hand when installing. The life of these rings was only about 30 days and gave considerable trouble by leaking most of that time, so that eventually I connected the 1/8" vent pipes to the condenser.

Being short of a set for installation at one time I cast a set on mandril and plaster of paris moulds, using Magnolia Metal, with such good results that I at once fitted all rods in a similar manner, the soft rings not being machined or scraped to place in either application, they ran for four months under my care without trouble, and I have since been informed that they were taken out two years after I left the vessel, worn out.

Very truly yours,
Grant H. Perkins
U.S.Local Inspector of Boilers, Juneau, Alaska.

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SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK, containing 680 pages, treating on over two thousand Engineering and Mechanical Subjects, brought up to date. We offer this valuable reference work at the low price of 40c postage prepaid. Address Montreal office.

The Four Essential Features

in the boilers of the up-to-date steam plant -

1. Capacity of Absorption and Transmission of Heat
2. Dryness of Steam
3. Safety at High Pressure
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have the greatest prominence in the

HEINE SAFETY BOILER

The Heine Boiler is not only constructed so that it will best absorb and transmit the heat, but also so that the heat will best reach it.

Careful selection and testing of materials guarantee perfect safety at high pressures, the boiler as a whole being submitted to a rigorous inspection and test before it leaves our shops.

Dryness is obtained by an active agent present at all times in the boiler, which becomes more rigorous the more the boiler is pushed.

The **HEINE MUD DRUM** most effectively precipitates and discharges all scale and mud.

Our literature will interest every actual or prospective boiler purchaser. Write for it to-day.

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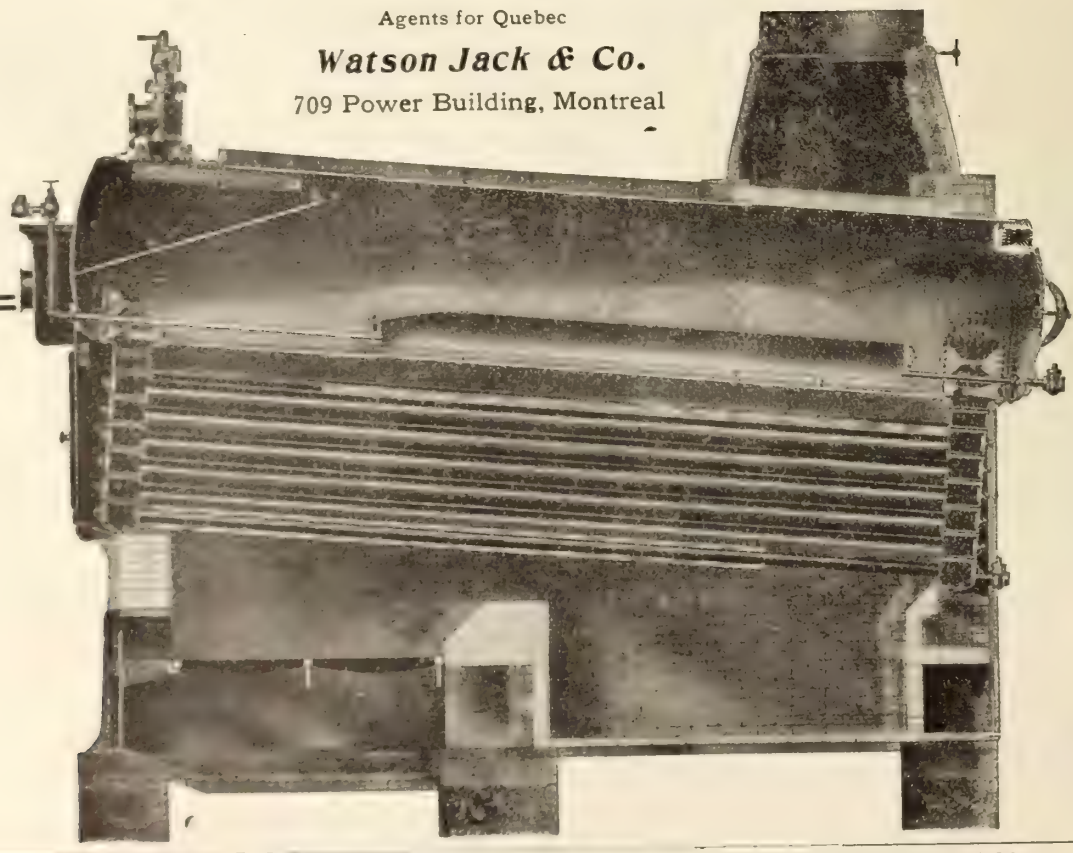
TORONTO, CANADA

Agents for Quebec
Watson Jack & Co.
709 Power Building, Montreal



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Boilers

OF ALL KINDS, FOR ANY PRESSURE

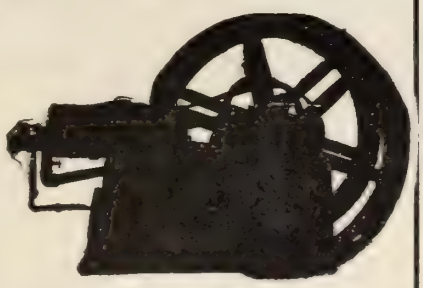
—Horizontal Stationary Tubular
—Vertical
—Locomotive
—Hoisting Engines and Boilers

We can also furnish steel tank work for any purpose. As we have a very large and thoroughly equipped boiler shop, you will find we can quote you very attractive prices. Send us your specifications.

William Hamilton Company, Limited
PETERBOROUGH : : ONTARIO

For Your Shop or Plant there is an I H C Gasoline Engine that Will Save You Work, Time, and Money

For a small or large shop or plant, wherever power is used to operate machines or to generate power for lighting, an I H C is the best-paying engine investment to make. This assertion is based on actual, proven facts.



I H C Gasoline Engines are steady and dependable because they are made on the correct mechanical principle. They are simple, have few parts, are easy to clean and to keep in working condition. They are economical because of the ingenious cylinder construction and the I H C system of governing.

The Best Power—In the Best Style and Size

A certain engine fits your work. You should get that particular style and size in order to make your engine pay the biggest possible dividends. I H C Engines are made in the following styles and sizes:

HORIZONTAL—1, 2½, 4, 6, 8, 10, 12, 15, 20, and 25-horse power
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Write for the I H C Engine Catalogue

Read up on engine construction before you decide. It's too costly to make a mistake. Yet there is no need of taking chances. The I H C trade mark stands for quality---the best engine you can get for your money Write postal for I H C catalogue now. Address

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McGill University,
Toronto University,
Queens University (School of Mining),
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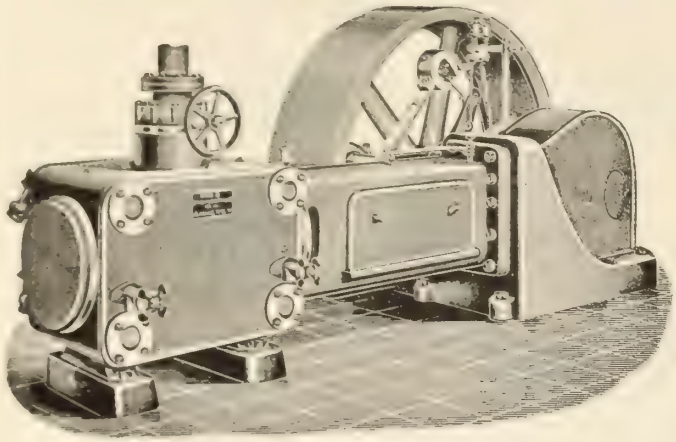
Above is only a partial list, but it is one with a message.

LAURIE & LAMB
Canadian Agents for BELLISS & MORCOM, Ltd.
211-212 Board of Trade Bldg., - MONTREAL

Robb Corliss Engines



Have the Armstrong-Corliss valve gear, which will operate at a higher speed than the ordinary releasing gear.

This valve gear does not depend on springs or dash pots for closing, and runs without noise.

The wearing parts of the valve gear are enclosed in a casing and run in oil so that friction is reduced to a minimum.

Robb Engineering Co. LIMITED

AMHERST, N.S.

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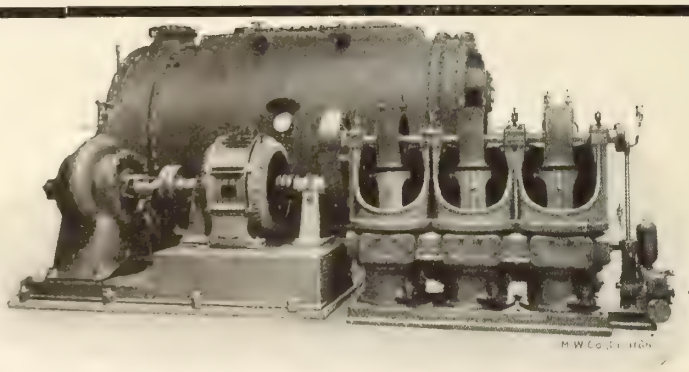
Highest Vacuum Special



Best Efficiency Designs

CONDENSING PLANTS

OF EVERY DESCRIPTION

Barometric Low Level Jet or Surface

All on the Counter-Current Principle

"Edwards" Valveless Air Pumps Dry Air Pumps

The Canadian Boving Co., Ltd., 164 Bay St.

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Vancouver Office: 427 Seymour Street. H. W KENT, Local Manager.

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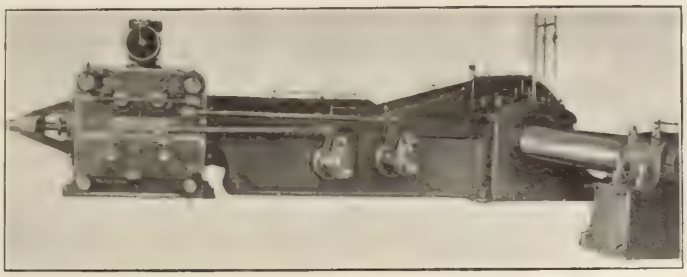
Leonard Corliss Medium Speed Engines



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Particularly adapted for Electric, Traction, Rolling Mill and Saw Mill Work

Economical, durable, absolutely noiseless, much less floor space occupied than Slow-Speed Engines, at the same time giving high economy. Built in either horizontal or vertical styles. Simple, Tandem and Cross Compound.

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Manufacturers of High and Slow Speed Engines of all kinds,
Boilers, Heaters, Tanks, Pumps and Steam Plants Complete

Canadian Agents for "Browett-Lindley" English High Speed Vertical Engines and "National" Gas Engines and Producers
Warehouses and Agencies at Montreal, Que., St. John, N. B., Calgary, Alta., Winnipeg, Man., Vancouver, B. C.

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WE are in a position to do repair work of all descriptions promptly and satisfactorily. We also do ship repairs. We are also glad to figure on any special work. Submit us your plans and specifications and we will be pleased to give you prices.

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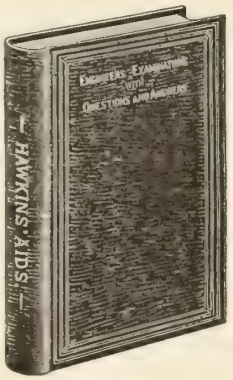

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It presents in a condensed form the most approved practice in the care and management of steam boilers, engines, pumps, electrical and refrigerating machines, with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.00.

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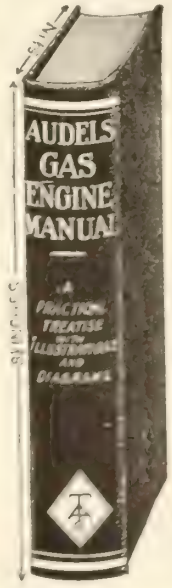
A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and maintenance of steam turbine plants and turbo-generators. 135 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



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By L. I. Wightman, E.E.

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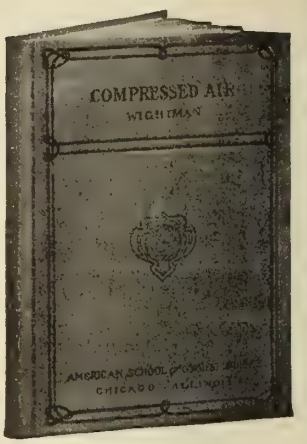

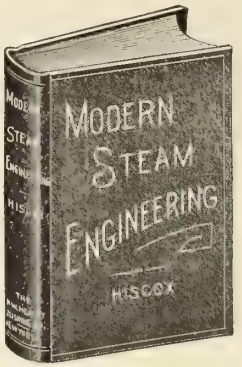

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This book has been specially prepared for the use of the modern steam engineer, the technical students, and all who desire the latest and most reliable information on steam and steam boilers, the machinery of power, the steam turbine, electric power and lighting plants, etc. 450 pages, 400 detailed engravings.—$3.00.

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The only book showing how locomotive boilers are built in modern shops. Shows all types of boilers used; gives details of construction; practical facts, such as line of riveting punches and dies, work done per day, allowance for bending and flanging sheets and other data that means dollars to any railroad man. 421 pages, 334 illustrations, six folding plates.—$3.00.

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Comprising the physical properties of air from a vacuum to its liquid state, its thermodynamics, compression, transmission and uses as a motive power in the operation of stationary and portable machinery, in mining, air tools, air lifts, pumping of water, acids and oils and the numerous appliances in which compressed air is a most convenient and economical transmitter of power.—Price $5.00.

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DOUGLAS & GRANT

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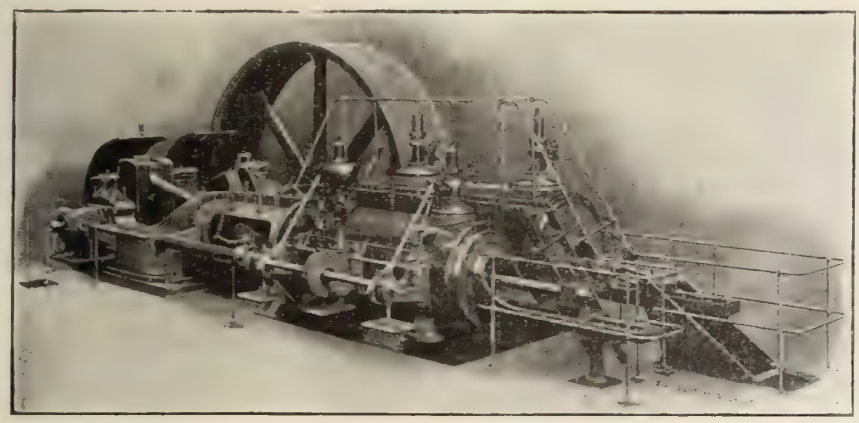
Sole Licensees for Great Britain and the Colonies of

CARELS DROP VALVE STEAM ENGINES

for HIGHEST ECONOMY and RELIABILITY



700 I.H.P SIDE-BY-SIDE ENGINE, WITH CARELS DROP VALVES

Also makers of Corliss Engines

Aero Condensors. All water recovered, none required for condensing, and heated air obtained for manufacturing purposes.

SURFACE and JET CONDENSERS, Etc.

STEAM and ELECTRIC HAULING and WINDING GEARS.

Large Pumps for WATERWORKS and MINES.

On British Admiralty and India Office Lists.

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That is an essential feature of pipe threading. Inaccuracy where pipe threading is concerned means trouble

The Forbes Pipe Cutting and Threading Machine

does accurate work. The dies revolve around the pipe, the machine and pipe remain stationary. One man can cut pipe with the FORBES. Furthermore, the machine can be taken right to the job.

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The Curtis & Curtis Co.

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LIMITED

PERTH, SCOTLAND

Manufacturers of

Gauge Glasses

"Perth" and "Unific" Brands

Received Thirteen Highest Awards for quality, the most recent being Diploma of Honour at Brussels, 1910.

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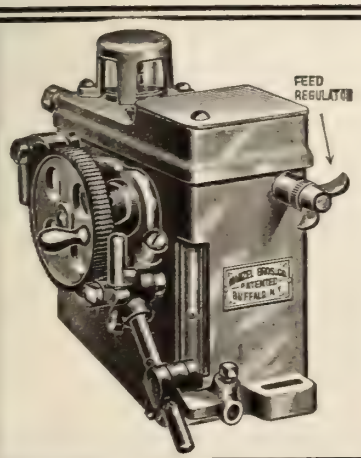

An Oil Saving Oil Pump

The Manzel Sight Feed Oil Pump will give your engine much better lubrication and save you at least 30% on your oil bill. It feeds just the quantity of oil required for *perfect* lubrication of the cylinder whether one drop is required every few minutes or a stream with every stroke. It can be regulated without stopping the engine. 30 days' free trial—send it back at our expense if it doesn't prove our claims. *Write for bulletin No. 210.*

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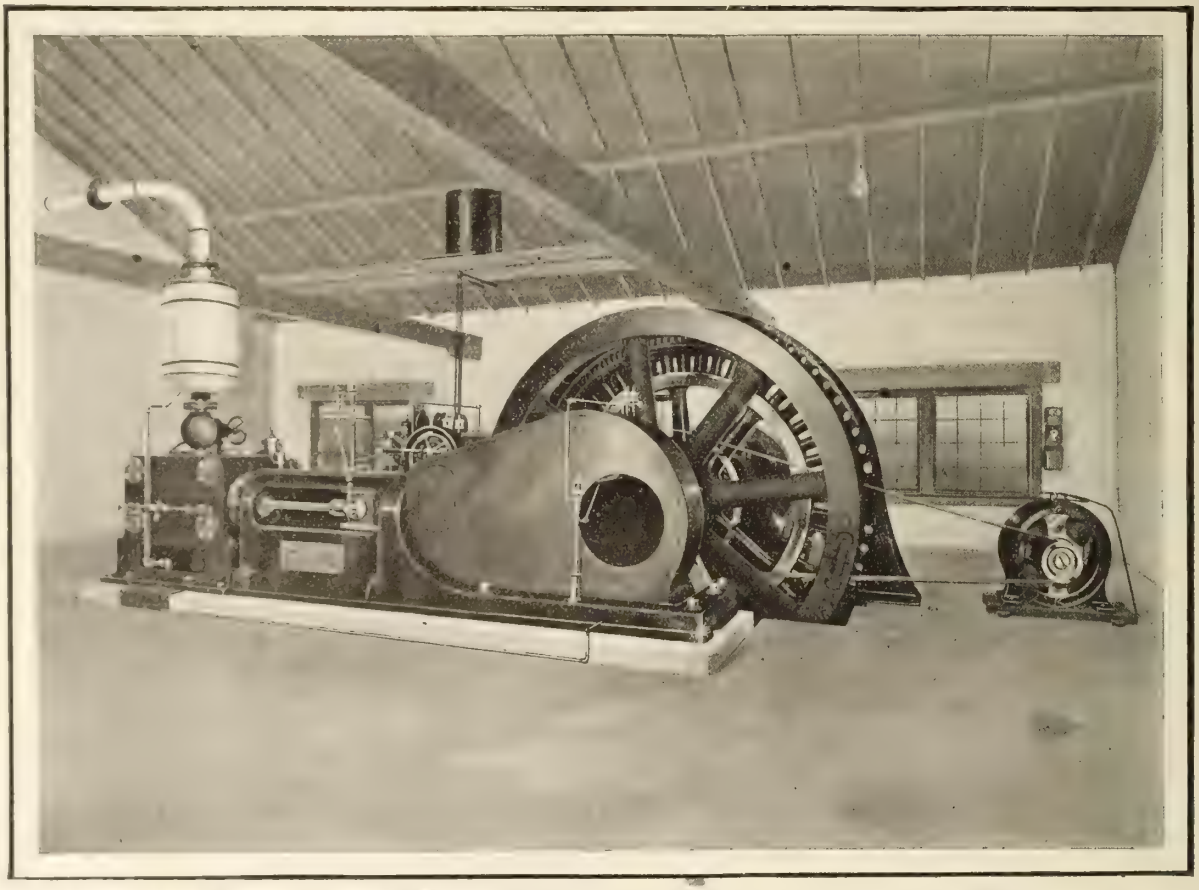
Your Exhaust Steam?



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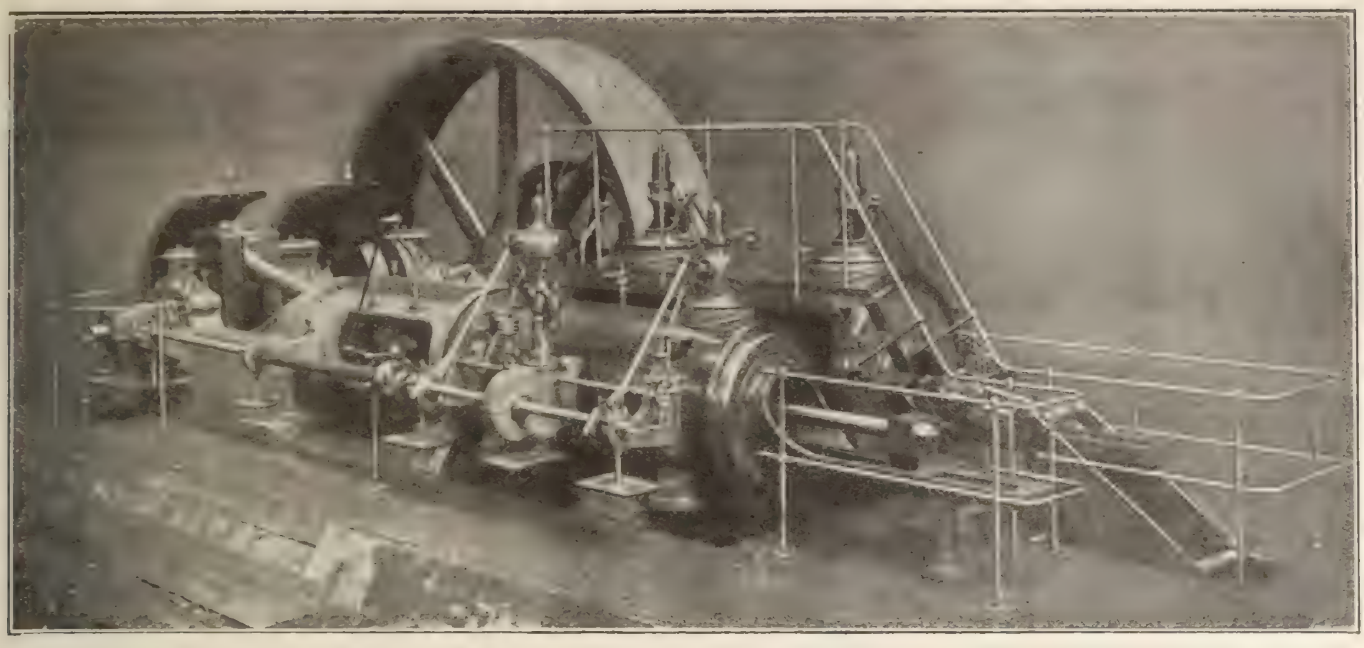


Fig. 1.- 600 I.H.P. Carels Compound Engine.

Detail Description of the Carels Drop Valve Engine

A Paragraph in This Descriptive Article States That Fifty Years Ago the Senior Partner of the Douglas & Grant Firm Took From the American Continent and Introduced Into Britain the Corliss Valve Engine. Their Appreciation of That Liberty Warrants Them in Returning the Compliment by Placing on the Canadian Market the Thoroughly Modern Carels Drop Valve Engine, Manufactured by Them.

DOUGLAS & GRANT, of Dunnikier Foundry, Kirkcaldy, Scotland, have just completed an engine possessing several points of interest. The engine is designed to give 600 indicated horse-power when running at 80 revolutions per minute, and using steam at 160 lb. pressure and 600 deg. Fahr. temperature. It has two cylinders, 21¼ in. and 38 in. in diameter respectively, each having a stroke of 42 in. Each cylinder is fitted with Carels' balanced drop-valves for steam and exhaust.

The cylinders, it will be seen, are arranged close to one another, and are connected by independent circular guides to a massive common bed-plate or frame, which carries the main crank-shaft bearings. The ends of the circular bored guides, nearest to the cylinders, have heavy feet cast on for bolting to the engine foundation, the cylinders being carried on a massive cast-iron beam of special design placed across the engine immediately in front of the back exhaust valves. Both piston rods are extended through the back covers of the cylinders, the vertical air-pump being driven by steel levers and rods from a crosshead attached to the extension of the low-pressure piston-rod.

The valve-gear follows exactly the approved design adopted by Carels Freres, of Ghent, the well-known Continental engine-builders, who have attained such extremely good industrial results with their drop-valve engines, of which over 400,000 horse-power are now at work in many different parts of the world.

The constant increase in steam pressures and temperatures has caused the more frequent adoption during recent years of drop-valves as compared with Corliss valves. Robert Douglas, the founder of the firm of Douglas & Grant, was the first maker of Corliss engines in Great Britain, he having introduced this type about 50 years ago from America. The firm have now secured the sole selling and manufacturing rights for the Carels' drop-valve engines in Great Britain and the British Colonies.

The engine illustrated is fitted with a main fly-wheel, 16 ft. in diameter, and grooved for sixteen 1¾-in. ropes ; alongside it there is a second pulley 8 ft. in diameter, grooved for eight 1¾-in. ropes, also for transmitting the power to the line-shafting. The engine has been built to the order of John White & Sons, Scotstoun Flour-Mills, Glasgow.

Douglas & Grant have also on order a duplicate of this engine for the York Street Spinning Company, of Belfast, the engine in this case being coupled direct to a continuous-current generator, and designed to run at 90 revolutions per minute. A further engine fitted with Carels' drop-valves,but with the cylinders arranged with a direct-current dynamo between the cranks, is being built by the same firm for the Balgonie Colliery Co., Fifeshire ; this set will be capable of giving 150 k.w. when running at a speed of 110 revolutions. All these engines are designed for continuous night and day running and for high steam pressures and superheat ; it is for this latter condition particularly that these drop-valve engines are so well suited.

The results obtained with the Carels' engine are equal, if not superior, to those of the best class of steam turbine and the fuel consumption approaches closely to that of gas engines and producers, while the reliability is much greater with an appreciably less initial cost.

Two types of drop valves in common use are the double-beat balanced seating and piston type. The Carels valve belongs to the former class and bears out in its obtained results, the general consensus of opinion that it is superior to the piston type in having a freer movement, an assured cut-off and ultimate tightness.

Fig. 1 shows a general perspective view of the complete 600 h.p. engine. Figs. 2 and 3 show cross section through the cylinders of a cross-compound Carels' valve engine.

The cylinders are in 3 pieces, consisting of one body and two ends. The low pressure cylinder barrel is steam jacketted, as are also the covers of both cylinders. The lagging of the cylinders is finished with planished steel.

The valves and valve seats, are cast of a special mixture, admitting of lightness combined with strength and durability. The seats are securely fastened into the cylinder ends and the valves ground into them under conditions approaching as nearly as possible to those obtaining under actual work.

The inlet valves are opened by a special trip gear and after disengagement fall rapidly until they close to steam. An adjustable air cushion reduces the fall, allowing them to finally seat themselves without shock or noise.

The governor is of the Hartung, Whitehead, or other approved type, and is driven by machine-cut bevel gear from the cam shaft : it is fitted with a hand-regulating device which can be operated while the engine is running : a suitable knock-off motion, combined with a

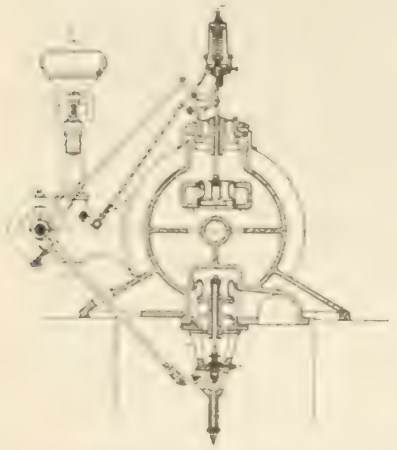


Fig. 2.—Cross Section Through Cross-Compound Engine. H.P. Cylinder.

vacuum breaker for condensing engines, is provided if desired.

The pistons are of the box type fitted with accurately machined Ramsbottom rings, both piston and rings being cast of a special iron mixture.

The crossheads are either of the solid forged or cast steel box type. In either case loose cast-iron slippers are secured

Fig. 3. Cross Section Through L.P. Cylinder.

to the crosshead and machined thereon so as to ensure accuracy of running.

The frame is of the girder type with circular bored guides and usually provided with a continuous sole bearing in its entire length on the foundation. The main bearings are of the four-part type, with single wedge adjustment, the bushes being of cast steel, lined with a special mixture of white metal.

Fly-wheels, whether grooved for ropes or with plain heavy rims, are made with solid oval section arms, the bosses being secured with heavy weldless steel hoops shrunk on : the rim joints of rope wheels are bolted together, the joints of plain wheels being dowelled and cottered.

A single or twin cylinder automatic barring engine is usually supplied in conjunction with these engines, and their adoption is recommended in preference to hand barring gear, especially for engines of any size.

Lubricating arrangements are most carefully carried out, sight feed controllable plunger pumps being used for the inlet valves and for the cylinder at each end of the stroke.

VALUABLE TO HIM.

Gentlemen,

I beg to acknowledge receipt of two issues of "The Power House," for November and December, 1910. *Please find herewith the sum of* $1 *as per my agreement.*

I may add that one paragraph alone was worth that to me.

The advertising matter is so interesting and so lucid as to form a volume of itself, showing, as it does, all the modern improvements, and in such form that one could hardly fail to recognize the original when seen for the first time.

I am very pleased with the issues and look forward to the others in due course.

Yours very truly,
Richard H. Webb,
384 McDonnell St.,
Peterboro, Ont.

For overhung crank pins a standard centrifugal oiler is used, while for the shaft bearings lubrication is effected by means of a small rotary pump driven from the engine.

Bain & Mitchell, Y.M.C.A. Bldg., Montreal, are the Canadian representatives.

GAIN BY EXPANDING TO LOW PRESSURES.

By H. F. Cram *

In naval reciprocating engines it is well known that, owing to considerations of weight and space, a large expansion was not given in full power ; in other words, economy at full power had to be sacrificed to other requirements in the warship compromise. Taking a number of representative reciprocating engines for our more recent warships with a fairly high steam pressure—viz., about 220 pounds per square inch by gage in high-pressure receiver—the average pressure at the completion of the expansion at full power is 12½ pounds absolute, with a back pressure, while the cylinder is open to the exhaust, of 6.7 pounds absolute, the average vacuum being 26 inches, or, say, an absolute pressure of two pounds per square inch.

Further, while the average back pressure in the low pressure cylinder was about 6.7 pounds absolute, or 16½ inches vacuum, the expansion only extends while driving the piston to about 12½ pounds absolute, or 5 inches vacuum, so that a considerable percentage of the energy in the steam which could be obtained by gradual expansion from 12½ to 6.7 pounds while doing work, is also lost.

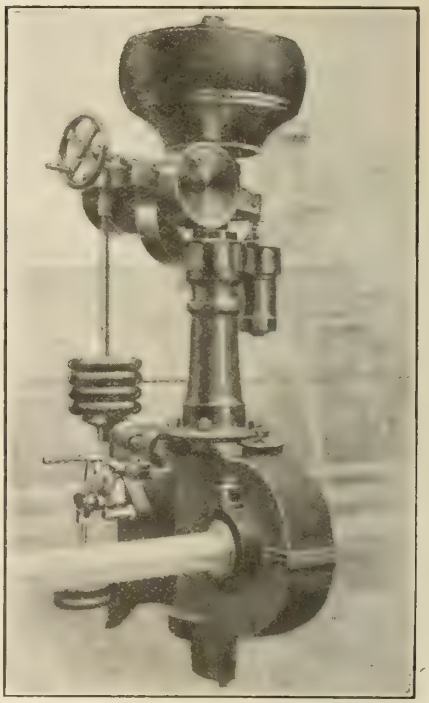


Fig. 4.—Hartung Governor Driven from Valve Gear Shaft.

In the turbine, however, instead of these comparatively high pressures at the termination of expansion, we have the fact that the steam does useful expansive work to about 27 inches vacuum at the turbine end, with a vacuum of 28 inches in the condenser, the necessary volume being obtained as indicated previously. At the other end of the scale the average steam pressure at the turbines has only been about 140 pounds in recent examples furnished by turbine ships of the British fleet.

*Engineer-in-chief of British Fleet, in Engineering.

Assuming adiabatic expansion, the following table shows the energy available in thermal units per one pound of steam when expanding between various pressures, and the comparatively large amounts obtained for small drops of pressure at low pressure :

Expanding from 235 pounds absolute to 16½ inches vacuum, 249 thermal units.

Expanding from 16½ to 20 inches vacuum, 16.2 thermal units.

Expanding from 20 to 22 inches vacuum, 11.8 thermal units.

Expanding from 22 to 24 inches vacuum, 15.1 thermal units.

Expanding from 24 to 26 inches vacuum, 21.4 thermal units.

Expanding from 26 to 28 inches vacuum, 31.9 thermal units.

It will be seen that the B.T.U. given up by the steam expanding adiabatically from a vacuum of 16½ inches to one of 28 inches is 38.7 per cent. of the B.T.U. available from an adiabatic expansion from 235 pounds absolute to 16½ inches vacuum, showing the great gain by the economical expansion to low pressures, and explaining the superior economy of the turbine.

Double Tandem Compound Stern Wheel Engines for C.P.R.

The Polson Iron Works Have Just Completed and Tested Under Steam in Their Yard Double Tandem Compound Engines for a C. P. R. Stern Wheeler—These are the First of This Type to be Built, and the Largest Stern Wheel Engines in Canada, the Over-All Length Being 75 feet.

Double tandem compound engines for a C.P.R. stern wheeler, first of this type to be built in Canada, were recently completed and tested by the Polson Iron Works, Toronto. The over-all length is 75 ft. The engines were designed to give a little over 1,000 horse-power when running at 25 r.p.m., cutting off at half stroke and with 200 pounds steam pressure at the boiler.

The high pressure cylinders are 16 ins. and the low pressure 35 ins. diameter with a stroke of 8 ft. The high pressure cylinders are placed forward of the low pressure with a cast steel distance piece between them which also forms the cylinder covers, and is firmly bolted to the cylinder beams. The cylinders have brackets cast on at each end, which also rest on the cylinder beams and are bolted to them, but the holes are made oval to allow for the expansion of the cylinders which is considerable owing to their great length.

The cylinder beams which form the bedplate or frame of the engine are box girders built up of plates and angle bars, and carry the cylinders, the guide bars, main bearings and brackets for for the valve gear.

Main Valves.

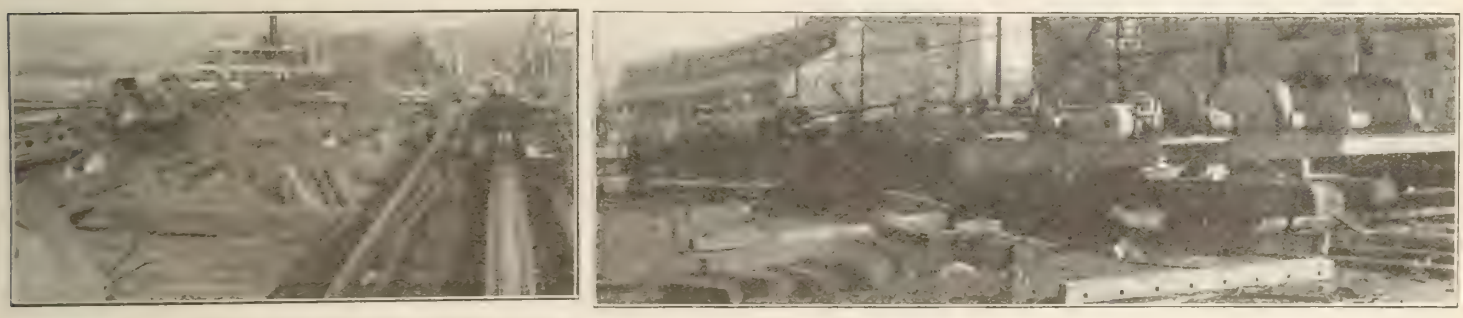
The main valves on the high pressure cylinders are hollow piston valves fitted with spring rings, while the low pressure has balanced slide valves. High and low pressure valves on each engine are connected to one spindle which is worked by a valve motion with a stationary link which gives the same lead to the valve in whatever position the block is placed. The point of cut off is altered or the gear reversed by moving the block in the link. A radius rod connects the block and the valve stem. The gear is actuated by a steam reversing gear of the direct type. The high pressure cylinder is fitted with a separate cut off valve working inside the main piston valve and worked by a separate eccentric. The travel of this valve is regulated by the position of a block in a separate curved link similar to the main link, except that the link is pivoted at one end instead of at the centre.

The piston rods and value stems are fitted with special metallic packing manufactured by the company. The after low pressure covers are made in halves to facilitate removal for inspection of the low pressure piston. The connecting rods which are 32 ft. long from centre to centre, are built up of steel plates, channels and tee bars, with solid forged steel ends, fitted with bronze bearings secured by straps, with gibs, cotters and bolts.

The crank shaft is a hollow forging of nickel steel fitted with solid forged steel webs, and weighs over ten tons.

The engine has been designed throughout with very ample bearing surfaces, and a large factor of safety as the nature of the service it is built for requires that there shall be no possibility of a break down, the boat having to be as regular in its trips as an express train.

The boiler is of the locomotive type, and is the largest boiler of this type which has been built in Canada, being 90" in diameter and 28' 4" long, and having a grate area of over 75 sq. ft. and heating surface of 2,750 sq. ft. The boiler is built for a working pressure of 200 pds. per sq. inch, and is designed to burn up to 3,800 lbs. of coal per hour under forced draft, air being supplied by a Sturtevant Multivane fan driven by a slow speed Sturtevant turbine.



C.P.R. Stern Wheeler Engines Built by Polson Iron Works. Double Tandem Compound Stern Wheeler Engine Built by Pol-on Iron Works, Toronto.

COST OF COMPRESSED AIR.

The total output of all the air compressor plants employed on the Panama Canal, during the year ending 30th June, 1910, was 7,227,203,510 cubic feet of free air, and the average cost was 4.03 cents per 1,000 cubic feet.

Mechanical Drawing and Sketching for Engineers*

By B. P.

A Series of Progressive Lessons Designed to Familiarize Engineers With the Use of the Apparatus Necessary to Make Simple Drawings, to Encourage them to Realize How Important a Factor it is of Their Equipment, as Well as Being a Profitable Pastime.

THE ability to put one's ideas on "paper" as it is called, is of more import than at first sight appears, and in passing let me say that without this means of developing and conveying ideas from one to another, we would not yet be far removed from the barbaric age in mechanical arts.

Purpose of Course.

You are not to run away with the idea that the purpose is to make a draftsman of you, and having that notion decide that as you are an engineer, this little instruction page need not be read. There will be, it is hoped, no limit to any position of responsibility or trust to which the instruction may lead, but to you particularly is attention directed.

The course will start right at the beginning so as to embrace all grades, and care will be taken to make the work interesting and not too heavy.

To those who have some experience along the lines of our subject, there will be found helpful hints and advice which will amply repay joining in the study.

Difficulties of Study.

Experience goes to show that the difficulty of those who would study in their leisure hours is not one of making a start, but rather a disinclination to keep it up after a short trial. Drawing and sketching is no exception in this respect.

To guard against this trouble I wish to point out a few of the causes why this state of things obtains, so that you may be on the alert when the symptoms appear.

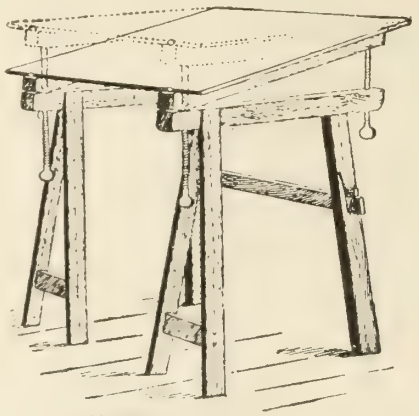
Most people are enthusiastic over anything new, especially if it appeals to their personal interests. Drawing or the desire to be able to make one, appeals to 95 per cent. of mechanics, young and old, not only as a trade help, but also as an enjoyable pastime and a medium by which their imaginative ideas and dreams may assume concrete reality.

The enthusiasm born of this appeal to study, will, as in every other like circumstance, bring a reaction, which coming as it does at a critical time in a drawing instruction course, will require the exercise of a good deal of patient determination.

The impression formed by nine out of every ten who take up study is that the acquirement of knowlege is easy. The prospectus descriptions of drawing courses are largely to blame for this.

The acquirement of knowledge is easy in no sphere or profession, and what is more to the point, the acquirement of the habit of study is less easy still. Too little stress is laid on the necessity of this latter, in fact it is practically ignored.

You have been in the habit of going out every night in the week after your day's work, to have a little legitimate recreation and amusement. You have often thought of studying mechanical drawing, but on account of the want of a proper opportunity you have never done so.



Adjustable Drawing Table.

The Power House, which you know is a reliable journal and to which you have been subscribing for years, comes along in February and outlines just the course you have long looked for. It takes little time for you to decide what you will do, and to be sure you lay your leisure time at its feet,with a generous hand. "I'll give three nights a week to this course, and run in a fourth occasionally."

You make this resolution without counting the cost. You forget that habits have been acquired that are antagonistic to study, and that those necessary cannot be donned in a moment as neither can the others be doffed.

Taking up the course with a rush as it were ensures a reaction, and unfortunately an unhealthy one at that. You are endeavoring to bite off more than you can chew, and my advice is—act cautiously. Set apart one night per week or at most two, and allow yourself to gradually break off the old habits and acquire the new.

Don't believe that it is easy to learn to draw, and that it can be mastered in so many days or weeks. Think of your stage of proficiency in your own particular line, and just figure to yourself how long it has taken you to attain it. Don't imagine that drawing is any easier and you will assuredly succeed.

By looking the matter square in the face thus, you will not get despondent when the reaction sets in and you register your progress as slow. You will not be a "sticker," when you look disgustedly at your drawing board, wondering where all the dirt came from that is on your paper, or amazed at the unintentional contortions you have given to straight lines, the variety of thickness of them, the seeming impossibility of making a circle without showing half a dozen joints and at the number and size of holes your compass needle point has been guilty of.

These experiences are real, troubles which all who would aspire to the making of a simple intelligible drawing will meet, and to minimize and combat which the advice and effort of this instruction course will be directed on your behalf.

Operating Hints.

In order to keep the drawing paper as clean as possible, see that your hands and finger-nails are carefully washed and attended to before commencing work.

Have your coat off, the sleeves of it in contact with the drawing impart dirt more or less.

Never sharpen your pencils over your drawing or in fact, over the table.

Use a hard pencil, say a 3H, it will last longer, need sharpening less often and will assist in keeping the drawing clean.

Wipe the dust from all your apparatus carefully with a clean duster before starting work, and cover up all when you finish each time.

Keep the particles of ground rubber brushed off the sheet, as they being coated with lead from the erased lines, will, if allowed to remain, be crushed against the paper by the movements over them of the squares.

The last instruction on cleanliness is keep your hands as far as is possible from touching the paper. Most people's hands perspire to a lesser or greater extent, and their contact consequently is not conducive to a clean drawing.

*First of a series of an Instruction Course. A lesson will be given each month.

DIRECTIONS TO FOLLOW IN CASE OF ACCIDENTS.

By G. C. Keith.

Engineers and firemen are exposed to a great many accidents and for want of the necessary knowledge of what to do, or in some cases what NOT to do, a life may be sacrificed or a great deal of suffering caused the unfortunate one.

We have heard of bursting flywheels on engines and exploding boilers. These have been guarded against by mechanical means. Safety stops have been designed which eliminate any chance of racing of engines. Safety valves are used on boilers and these, with careful inspection, have brought accidents due to a boiler explosion to a minimum.

However, accidents will happen, gauge glasses will break, etc., and a burn or scald that is very severe result. In the case of either of these accidents, dress the part with cotton, the object being to exclude the air. If cotton cannot be procured, apply any covering until you have an ointment made of beeswax and sweet oil, equal parts; or lime water and linseed oil; or lay on scraped potatoes or carrots; or mud; or sprinkle flour on the injured surface when the above cannot be procured. These are particularly serviceable where the skin comes off. Where the skin is not removed soda or starch made into a thick paste relieves the pain.

If the scald is extensive, and on the body, cold applications are not proper; keep the air from the wound as much as possible; do not remove the dressing often. When a cold lotion is used, pour it first on rags and let them remain undisturbed.

Carbon Monoxide.

When a substance containing carbon burns in an insufficient supply of air—as for example, when the draft in a furnace is not strong enough to remove the products of combustion and supply fresh air—the oxidation of the carbon is not complete, and the product instead of being carbon dioxide is carbon monoxide Carbon monoxide is a colorless, tasteless, odorless gas, insoluble in water. It burns in the air with a pale blue flame, forming carbon dioxide. It is exceedingly poisonous when inhaled and should not be allowed to escape into the power plant or into any room where there are human beings. Death is sometimes caused from coal stoves and defective furnaces, most dangerous gas coming from them being carbon monoxide. A pan of smouldering charcoal also gives off this gas. It acts on the red corpuscles in the blood. These carry the oxygen to the body thus making heat They are killed by the gas, the result being death. A doctor would tell you that it combined with the haemolglobin of the blood preventing aeration. If you find a person affected by this gas get him to fresh air and then make him breathe deeply.

Carbon Dioxide.

Carbon dioxide is a colorless gas at ordinary temperatures. When subjected to a low temperature and high pressure, it is converted into a liquid; and when some of the liquid is exposed to the air evaporation takes place so rapidly that a great deal of heat is absorbed and some of the liquid becomes solid. The gas has a slightly acid taste and smell

Carbon dioxide is much heavier than air, its specific gravity being 1,529, the so-called soda water is water charged with carbon dioxide under pressure.

Carbon dioxide is not combustible nor does it support combustion. Just as it cannot support combustion, so also it cannot support respiration. It is not poisonous any more than water is; but it cannot supply the oxygen which is necessary for breathing purposes, and hence any one in an atmosphere of carbon dioxide dies from suffocation, as they do by drowning.

The quantity of carbon dioxide in the air is relatively very small, being about 3 parts in 10,000 parts of air. It varies slightly according to the locality and the season. Any considerable increase in the quantity of carbon dioxide above this amount is objectionable for the reason that it decreases the proportion of oxygen in the air to be breathed. It is found that as much as 5 per cent. of pure carbon dioxide may be present in air without causing injury to those breathing it. It is often found in mines, wells, vats and holes in the ground as it is heavier than air. If an unsuspecting man goes into it he is at once suffocated, gasps and falls; some one not understanding the cause of the trouble goes down, and he will also become a victim. Many lives are annually lost in this way.

A very good way for a man who has to go into a vat or well, especially around a brewery, soda water works, etc., is to take a lighted candle or lamp with him, holding the light as low as his waist so as to be considerably below his mouth or else it will do no good. If the light goes out or becomes very dim he should stop at once for another step might bring him down into the gas and one breath of it will render him helpless. Another way is to fasten a candle to a wire and lower it into the vat or well. This method is not attended with any risk whatever.

Electric Shock.

At the recent convention of the British Medical Association an interesting paper was read on the subject of electric shocks. It has been noted that deaths have occurred due to shocks from 100-volt currents, while at other times a 1,000-volt circuit has failed to kill. It was pointed out that aside from voltage, the amperage and the character of the current, whether direct or alternating, the duration of the shock and its point of application, must be considered. The resistance of the skin has much to do with the matter, and the effect on one individual may differ greatly from that on another. The condition of the mind is also of importance, for a person who is prepared to receive a shock is less liable to be affected by it than one who receives it unexpectedly and accidentally.

Electric shock causes a stoppage of the heart's action exactly as drowning or suffocation. There is, therefore, always hope of resuscitation, except when the respiratory nerve centre has been destroyed. Accidental shocks seldom result in absolute death unless the victim is left unaided for too long a time, or efforts at resuscitation are suspended too early.

In the majority of instances the shock is only sufficient to suspend animation temporarily, owing to the momentary and imperfect contact of the conductors, and also on account of the indifferent parts of the body submitted to the influence of the current. It must be appreciated also that the body under the conditions of accidental shocks seldom receives the full force of the current in the circuit, but only a ehort circuit which may represent a very insignificant part of it.

When an accident of this nature occurs, the following rules of M. D'Arsonval, should be promptly adopted and executed with due care and deliberation.

(1) Remove the body at once from the circuit by breaking contact with the conductors. This may be accomplished by using a dry stick of wood which is a non-conductor, to roll the body over to one side, or to brush aside a wire, if that is conveying the current. When a stick is not at hand, any dry piece of clothing may be utilized to protect the hand in seizing the body of the victim, unless rubber gloves are convenient. If the body is in contact with the earth, the coat-tails of the victim, or any loose or detached piece of clothing, may be seized with impunity to draw him away from the conductor. When this has been accomplished, observe rule 2. The object to be attained is to make the subject breathe and if this can be accomplished and continued he can be saved.

(2) Turn the body upon the back, loosen the collar and clothing about the neck, roll up a coat and place it under the shoulders, so as to throw the head back, and then make efforts to establish artificial respiration (in other words make him breathe), just as would be done in the case of drowning. To accomplish this, kneel at the subject's head, facing him, and seizing both arms draw them forcibly to their full length over the head, so as to bring them almost together above it, and hold them

there for two or three seconds only (This is to expand the chest and favor the entrance of air into the lungs.) Then carry the arms down to the side and front of the chest, firmly compressing the chest walls, and expel the air from the lungs. Repeat this manoeuvre at least sixteen times per minute. These efforts should be continued unremittingly for at least an hour or until natural respiration is established.

(3) At the same time that this is being done, someone should grasp the tongue of the subject with a handkerchief or piece of cloth to prevent it slipping, and draw it forcibly out when the arms are extended above the head, and allow it to recede when the chest is compressed. This manoeuvre should likewise be repeated at least sixteen times per minute. This serves the double purpose of freeing the throat so as to permit air to enter the lungs, and also, by exciting a reflex irritation from forcible contact of the under part of the tongue against the lower teeth, frequently stimulates an involuntary effort at respiration. If the teeth are clenched and the mouth cannot be opened readily to secure the tongue, force it open with a stick, a piece of wood or a handle of a pocket knife.

Dr. Augustus H. Goclet adds another method which may be followed if the above does not work. He says:

"The dashing of cold water into the face will sometimes produce a gasp and start breathing, which should then be continued as laid down by D'Arsonval. If this is not successful, the spine may be rubbed vigorously with a piece of ice. Alternate application of heat and cold over the region of the heart will accomplish the same object in some instances. It is both useless and unwise to attempt to administer stimulants to the victim in the usual manner by pouring it down his throat."

Series of Practical Questions and Answers for Engineers

By A. E. B.

Every Care is Being Taken to Include Only Pertinent Practical Questions, and Give Same, Direct Reliable Answers. Catch Questions will be Avoided. The Knowledge of Simple Addition, Subtraction, Multiplication and Division of Decimals, Will be Found a Most Useful Companion Study, and Should Not be Overlooked.

28—Q. What advantage has the corliss valve and its arrangement on a steam engine over that of a slide or piston valve, and what are its disadvantages in comparison?

A. It reduces the port clearance to a minimum, gives the practically full steam admission opening and sharp clean cut-off instantaneously, permits of water [illegible] the exhaust ports, is adaptable to close governing and gives independent exhaust valve adjustment.

Its principal disadvantage is in the number of revolutions per minute; these being limited to 150 probably as a maximum, due to the uncertainty of the trip gear engaging and disengaging properly.

29—Q. What are the usual arrangements of [illegible] valve gear in steam engine practice?

A. 1—Gears without trip motion, the valves having a positive connection with the eccentric, the travel constant, and the point of cut-off invariable. This arrangement is not much used.

2—Single eccentric gears with trip motion in which the steam valves are not positively connected to the eccentric, but are opened by trips or catches against the resistance of a dashpot and released at some point of the engine stroke, determined by the governor or otherwise. The exhaust valves are positively connected to the eccentric and receive therefore a constant movement.

3—Double eccentric gears with trip motion in which the steam valves [illegible]

30—Q. What advantage has the piston valve over the ordinary slide valve, and in what circumstances is it used?

A. It is more perfectly balanced being as nearly as possible in equilibrium, thereby reducing the strain on the valve rod and gear due to valve and valve face friction. It is used in preference to a slide valve for the above reason, when the working steam pressure is high and when the necessary slide valve would be of large area.

31—Q. What is meant by a jet condenser?

A. By a jet condenser is meant the mechanical arrangement by which the exhaust steam from an engine cylinder is converted in water. It consists of a box or chamber into which the exhaust steam passes at its top end, and meets a jet or spray of water. The condensed steam is termed the water of condensation, the jet or spray the condensing water.

32—Q. What is meant by a surface condenser?

A. By a surface condenser is meant the mechanical arrangement by which the exhaust steam from an engine is converted into water by coming into surface contact with blocks of small brass tubes (usually ¾ inch diameter), through which water is being forced or drawn by a pump for the purpose.

[illegible] Under what conditions are each used?

A. The jet condenser is used when a plentiful supply of fresh water is available, costing nothing, and the boilers are fed from the hot well.

The surface condenser is used [illegible] is not available and the boilers are often fed from the hot well.

A steamer plying on a fresh water lake and one plying on the ocean are excellent examples of the respective uses of each. Jet condensers are largely used on stationary engines when fresh water is available.

34—Q. Which is the more costly, a jet or surface condenser?

A. The surface condenser costs considerably more.

35—Q. What is understood by the term air pump as applied to a condenser?

A. By the air pump is meant the apparatus by which the water of condensation and condensing water is withdrawn from the jet condenser, and by which the water of condensation only is withdrawn from the surface condenser.

36—Q. Would the air pump be of the same size for both a jet and surface condenser in the same size engine?

A. No, the air pump would be considerably larger with a jet condenser because it has much more work to do. See answer Q.—35

37—Q. Why are the tubes beaded on the rear head of a return tubular boiler, and need they be so on the front head as commonly practiced?

A. The tubes are beaded on the rear head because the thin edge projecting beyond the plate is removed a considerable distance from the water and meets the gases from the firegrate before they have transmitted their high temperature heat sufficiently to ensure against the tube ends becoming red hot, burning and loosening the effectiveness of the tube expanding.

They need not be beaded on the front head because by the time the gases reach there, their temperature is or should be reduced on economical grounds to a point below that of danger

of burning. Further, the gases are passing out instead of coming in and impinge less hurtfully on tube edges.

38—Q. Why is the return tubular boiler set in brickwork so much in favor as to be generally used in factories?

A. Because it is cheap to construct, therefore a low first cost to its owner, and compares favorably with other types in economical efficiency and lasting qualities, if properly designed, constructed, operated and cared for.

39—Q. What constitutes exhaust lead and exhaust lap?

A. The terms exhaust lead and lap apply to the slide and piston valves of a steam engine in their middle position on the cylinder valve face, when showing in the former case the ports to cylinder and exhaust pipe open to each other, and in the latter case closed to each other in excess of the clipping amount. See sketch under principles involved in answers to questions.

10—Q. What is the effect of exhaust lead?

A. Exhaust lead permits of an earlier release or escape of steam and a later compression or closing of same to the exhaust pipe, at the end of the cylinder from which the piston is going and to which it is coming in each case respectively.

11—Q. What is the effect of exhaust lap?

A. Exhaust lap permits of a later release or escape of steam and an earlier compression or closing of same to the exhaust pipe, at the end of the cylinder from which the piston is going and to which it is coming in each case respectively.

12—Q. How is the surface of a bearing reckoned and why?

A. The surface is found by multiplying the diameter in inches by the length in inches. Example—A 3 inch diameter shaft running in a 6 inch length bearing would be reckoned as having 18 square inches bearing surface.

The reason for the diameter being used in the calculation instead of the circumference is that the pressure is not exerted all round the bearing but only top and bottom, front and back, as the case may be, and on either one alone at a given time. The effective surface to take this pressure is one third of the circumference, and one third of the circumference is equivalent to the diameter, hence the use of the latter in the calculation.

Explanation of Principles Involved in Answers to Questions

By Pedestal

The Bolstering up of Oneself With the Memorizing of a Series of "Don'ts," With Bald Knowledge Given of What You Should do, and the Cramming of Your Head With "Kinks," Will be of Little Service in Enabling You to "Hold Down" a Position, if You Have Neglected to Add Intelligence to Your Knowledge. Many a Child Can Repeat the Alphabet, but Cannot Distinguish One Letter From Another. In This Series we Aim to Help You.

CORRECTION.

Due to the misplacement of a line in the first two paragraphs under the heading "Engines" in this section of our January issue, the sense and meaning intended to be conveyed was lost. We are therefore making a reprint of the text.

ENGINES—Reprint.

Figs. 1 and 6 represent the proper relation of eccentric and crank when a slide or piston valve is used on a steam

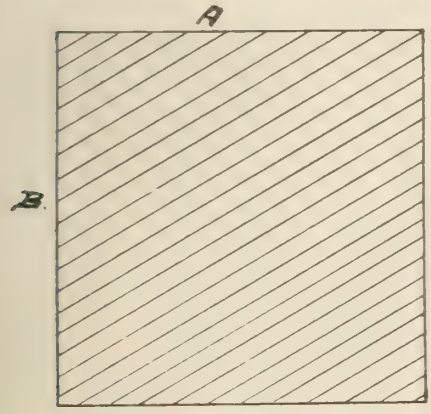


Fig. 1.

engine and the steam admission is over the ends of the valve.

Figs. 2 and 7 represent the proper relation of eccentric and crank when a piston valve is used with steam admission at centre.

In the first case Q26, the eccentric is set in advance of the crank, while in the second case Q27, (latter part of answer) the eccentric is set behind the crank and in an exactly opposite position to the other.

This of course is as it should be, the admission being at the opposite edge of the port and the valve movement being also in the opposite direction to attain it.

MENSURATION.

Area and Circumference of Circles.

There are few doubtless of our readers unable to figure out the area or circumference of a circle. The constantly recurring call for them has led to tables being inserted in text books, pocket books, and various other mediums of engineering information. Some of these tables in their scope and reliability are among the most valuable accessories to rapid determination of design, construction and operation, that those connected with engineering possess.

The purpose of this paper is not in any way to discourage the use of tables of areas and circumferences, nor is it to tell you that multiplying the square of the diameter by .7854 will give you the area of a circle, and further that multiplying the diameter by 3.1416 will give you the circumference of a circle. It is rather presumed you are fully conversant with these, and if not you should be, forming as they do the leading letters as it were of an engineer's alphabet.

The matters pertaining to area and circumference of circles which I am afraid are not too well and intelligently understood and to which your attention is directed, are why this squaring of the diameter and this multiplying by .7854 in the one case, and this multiplication of the diameter by 3.1416 in the other.

Fig. 1 represents a square which for our purpose will be called a 1-inch square, that is all its angles are right angles, all its sides are equal being each 1 inch long, and its area one square inch. Its area one square inch is form-

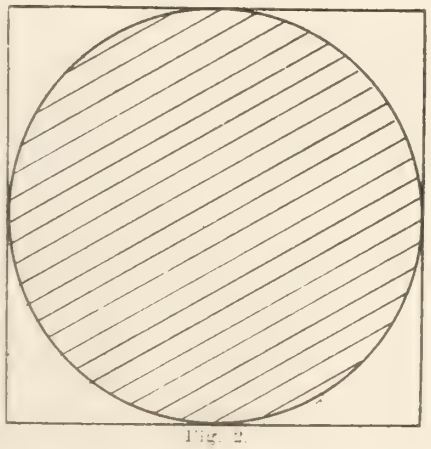
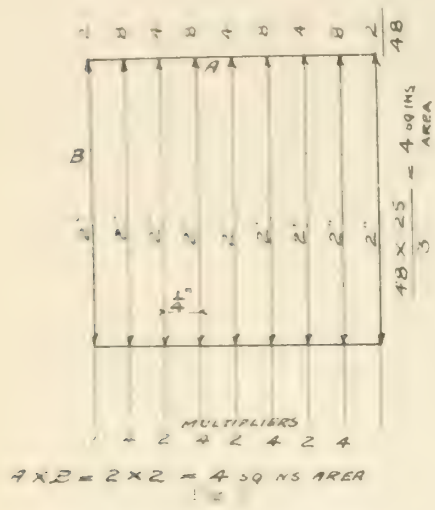


Fig. 2.

ed by measurement, if you choose, or by multiplication, which is the more intelligent method, of two adjacent sides

together. Thus: A x B equals 1 x 1 equals 1 square inch. The area is represented by the shaded portion.

Fig. 2 represents the same square with an inscribed circle whose diameter 1 inch is equal to the width or side of square. The shaded portion in this case represents the area of the circle, and is at once apparently something less than



that of the square, or put in other form bears a certain ratio to it.

The area of the square as we have seen is 1 square inch, the area of its inscribed circle is .7854 square inches. The loss of area due to the four corners is represented thus: 1 minus .7854 equals 2146 square inches. To make my explanation somewhat clearer, let us suppose you purchase a piece of jointing material 1 foot square, for which you paid a dollar or 100 cents. You purchase a further piece 1 foot diameter for which you pay 78.54 or 78½ cents. In each case you paid for the amount of material received, in a word the number of square inches purchased.

An easy and graphic method of proving or testing the conclusion is by Simpson rule of ordinates. The square Fig. 3 and circle Fig. 4 is divided up into any number of equal divisions, with distinguishing figures as shown, care being taken that reading from either end is the same. The height of each ordinate is multiplied by its distinguishing figure, and the totals of all the ordinates thereafter are added together and multiplied by one third of the space between them.

Turning to the circumference of the circle and the constant number 3.1416 we continue the reference to the square Fig. 1.

We have already noted that the sides are equal and each 1 inch long. The total length or circumference of the square will therefore be 4 inches, and is in all cases directly proportional to the length of side. Our inscribed circle is as we have seen only .7854 of that of the square, therefore its circumference will have a length equal to .7854 of that of the circumference of the square, .7854 x 4 equals 3.1416. The diameter being 1 inch, dividing 3.1416 by it gives of course the same results.

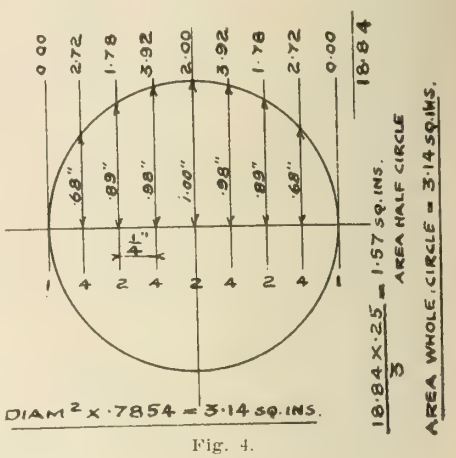


Fig. 4.

No matter what size of square is taken its inscribed circle will always bear the same ratio, both as regards area and circumference, which is as we have seen .7854 of either.

It is only necessary to take the half circle when testing by ordinates in Fig. 4, and double up in your answer.

A System of Storing Surplus Heat During Light Loads

Thermal Storage Does Thermally in the Production of Steam What a Flywheel Does Mechanically in Steadying the Action of a Prime Mover—Surplus Heat is Stored During Light Loads, Which Can be Drawn Upon to Meet the Heavy or Peak Demands, so That the Actual Load on the Boilers Themselves is Equalized to the Greatest Possible Extent Over the Whole 24 Hours—Tests by Dr. Unwin, F.R.S., Show an Economy of 19.4 Per Cent. in Favor of Thermal Stor-

THIS system was designed and patented by Druitt Halpin, of Westminster, and is an improved method of operating boiler plant where the demand for steam is irregular, a condition existing in most industries, and especially in electricity supply stations, steel and iron works, bleach and dye works, paper mills, sugar factories, collieries, etc. This system is particularly effective in connection with refuse destructors where use is made of the steam generated by the burning of refuse. It has also been applied to a large number of locomotives with excellent results.

The thermal-storage vessel consists of a [illegible] cylindrical drum, of predetermined capacity, fixed in any convenient position over the boiler, and connected to it by a steam pipe of suitable size, the [illegible] boiler being carried down inside the steam connection as shown in Fig. 1.

The feed water is pumped into the steam space of the thermal-storage vessel (instead of directly into the boiler in the usual way) at a rate which will supply the needs of the plant during the light loads, and at the same time ensure the storage of sufficient heated water in the thermal-storage vessel to carry the whole of the peak load. Referring to the curve shown in Fig. 2, it will be seen that the heavy load is on for about five hours in the evening. At the commencement of this peak load the feed pumps would be stopped, and the boilers fed by gravity from the thermal-storage vessel with the water previously stored up, which would be at the same pressure and temperature as that in the boiler.

Pure Feed Water.

Instead of the feed water being taken directly into the boiler, it is pumped into to the steam space of the thermal-storage vessel, where, by coming into intimate contact with live steam, it is heated up to a temperature corresponding to the pressure in the boiler. This has the effect of throwing down the lime, etc., contained in the water, and as no part of the thermal-storage vessel is in contact with heat from the fires, the deposit cannot be baked on to the plates, but remains in a soft state in the thermal-storage vessel, from which it can be discharged through the blow-off cock provided, and the boiler is supplied with pure feed at steam temperature.

Fuel Economy.

Tests carried out on a Cornish boiler by Dr. Unwin, F.R.S., showed an actual economy in coal of 19.4 per cent. in favor of thermal-storage. As these boilers were new and the evaporation without thermal-storage was over 10 lbs. of

water per lb. of coal, the results obtained by the use of thermal-storage may be considered exceedingly good.

Tests made on Lancashire boilers running with and without thermal-storage showed a saving of 21.7 per cent. in favor of Halpin's system. After the official trials the owners, to satisfy themselves, ran a further continuous test for 28 days and nights, obtaining an economy of 21 per cent. when using thermal storage. Other trials have given equally good results, and where coal is dear this economy in working must appeal to all steam users.

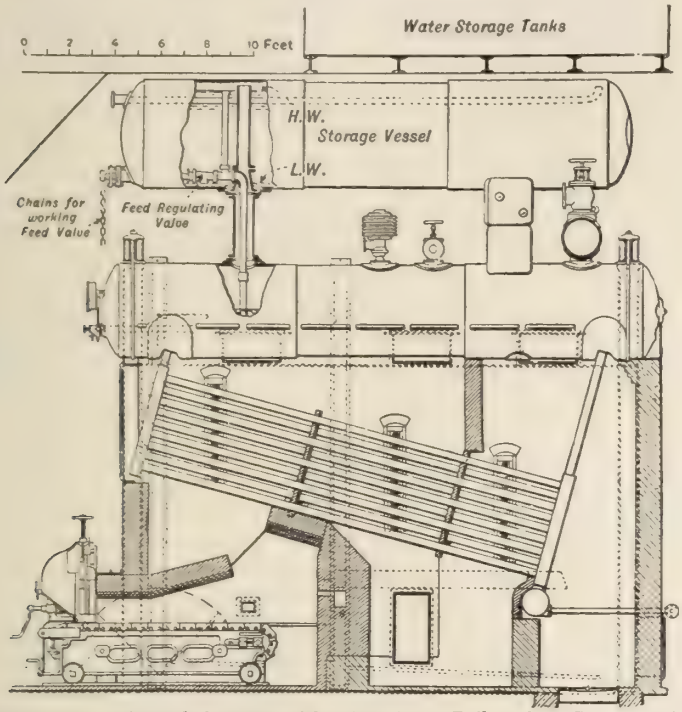


Fig. 1.—Arrangement of Thermal Storage With Water-Tube Boiler. The Canadian Agency is the Canadian Boiling Co., Toronto, of Which F. A. Yerbury is Vice-Pres. and Gen. Manager.

CENTRIFUGAL PUMPS FOR BOILER FEEDING.

According to established practice in boiler feeding a centrifugal pump would be about the last kind of pump which one would select for this purpose. If the exhibit at "Olympia," London, of Messrs. The Worthington Pump Co., of London and Newark-on-Trent, is any criterion we may be on the eve of a revolution in this branch of engineering. During the Engineering Exhibition recently held there this firm showed on their stand a centrifugal boiler feed pump driven at high speed (3,000 revs. per minute approx.) by a steam turbine, direct coupled and mounted on a bed plate, pumping against a pressure of 200 lbs. per square inch, the whole forming a very compact arrangement.

Considerable advantages are obtained over plunger pumps and the makers have such faith in this departure that they appear to regard centrifugal pumps as destined to supersede the other in the immediate future. I was told they are practically giving up the manufacture of direct acting steam feed pumps except to specified orders. The new pumps lend themselves admirably to direct coupling to electric motors and steam turbines, and the necessity for immediate gearing is removed. The defects experienced with geared pumps are thus eliminated. There is a gain in economy especially when the rate of evaporation in the boiler is steady. Relief valves are not required, as the flow of water is steady and owing to the principle of the pump there is immunity from accidents as the closing of a valve or other stoppage in the discharge main cannot produce an increase of pressure which would endanger the safety of the system.

Some efficiency and duty curves published by the makers show that the best duty obtained with a direct-acting steam pump is less than that obtained with the centrifugal pump at one quarter load. At full load the centrifugal pump delivers about two and a half times the quantity of feed water pumped by the former. A number of these pumps have already been supplied to various users.—National Engineer.

R. H. Nichols, Vandeleur & Nichols, Toronto, has just returned after a visit of seven weeks in England. While abroad Mr. Nichols visited the firm's various principals. He reports a constantly growing interest in Canada on the part of British manufacturers, and looks to see considerable development along these lines.

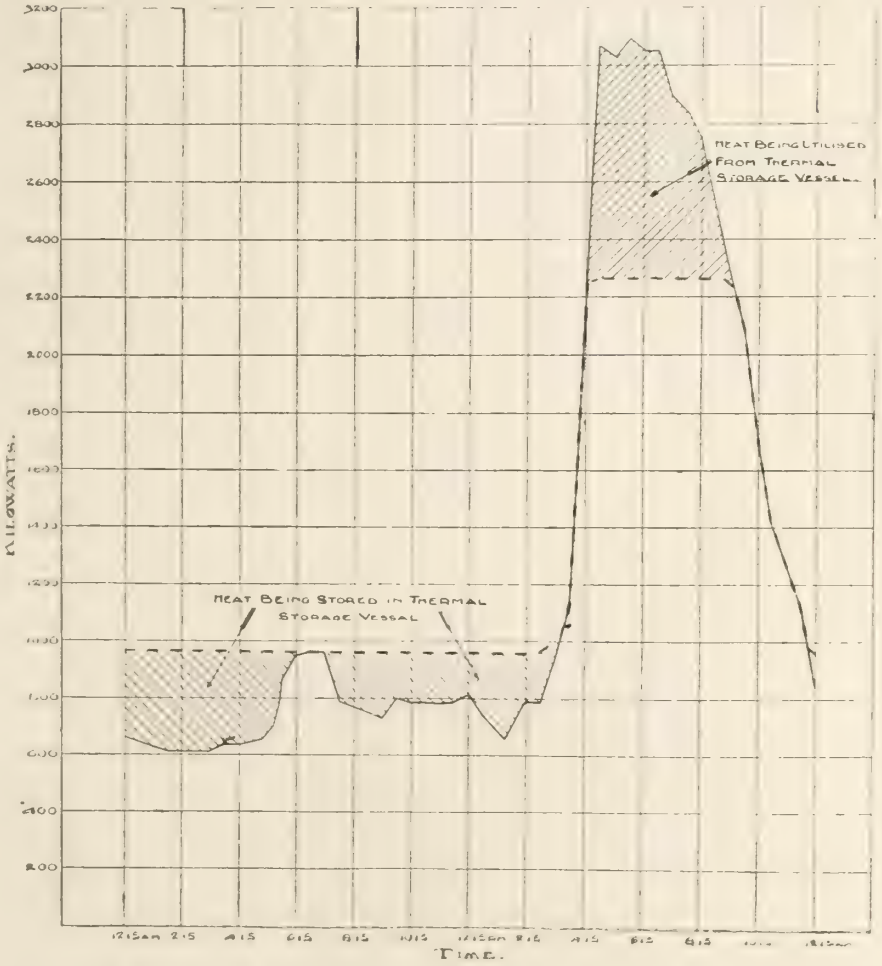


Fig. 2.—Actual Load of Power Station Equipped With Thermal Storage.

Boiler Design, Construction, Operation, Repairing and Inspection *

By H. S. Jeffery

Size and Number of Boilers.

(8) In deciding upon the length and diameter of a tubular boiler, the boiler designer is called upon to consider many matters. The steam pressure per square inch is one consideration, and the boiler horse-power desired another consideration. Decide these; then size and number of boilers.

The solution of whether one large boiler, or two or more smaller boilers should be installed, must be governed by the circumstance of each case. The plant may be one where there is an occasional use for nearly the full capacity of a large boiler, say 72 inches by 18 feet, but where the ordinary requirements could be fulfilled by a smaller size boiler.

In such a case—and they are frequent—the boiler designer knowing that a given horse-power is occasionally required, might design for the plant one large boiler with another boiler designer might design for the plant two smaller boilers, making the capacity of each boiler sufficient for ordinary requirements, only one boiler being in use

then for another plant of like character will design two smaller boilers. This would seem as an act of inconsistency on the part of the boiler designer, but usually there are sound reasons for such action.

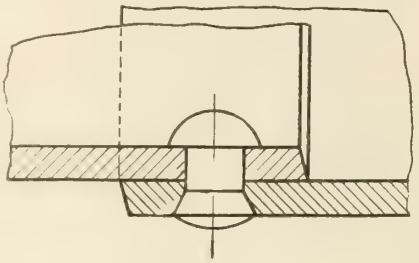


Fig. 9.

The purchaser will be inclined as a rule towards the large boiler rather than two smaller boilers on account of the former in regards to first costs being cheaper than the latter. The purchaser frequently lays too much stress upon the "first costs," overlooking that what is the cheapest at the outset may be the dearest after all.

The boiler room having only one boiler usually means Sunday work for the operating engineer; the passing over until a "more favorable time" repairs which should be made promptly and which if made at the right time would in many instances have saved the owner considerable, and in other cases would have prevented a boiler disaster.

With a battery of boilers the boiler designer has greater opportunity to make the design more perfect, both in regards to first costs and fuel consumption. With a battery of boilers it is not difficult to cut out of service one boiler for repairs without causing a shut-down of the plant or part thereof—in fact it is the practice with some when installing a battery of boilers to install one or two more boilers than necessary, the same being out of service, except when used in lieu of one of the regular boilers.

This practice is very commendable, for it permits repairs to be made promptly to a boiler; also, the boiler to be cleaned and inspected from time to time and other such features which can be accomplished in conjunction with regular duties.

It is advisable and true economy as a general rule not to depend upon one boiler. There are instances where plants at their busiest season, employing considerable force, have had to shut down for several days in order to make repairs to the boiler. If an extra boiler had been installed this could have been avoided, and by using the extra boiler now and then, permits proper attention to be given to both boilers.

The designer is sometimes confronted with this problem. It may be agreeable to the purchaser to install two boilers, but the space for the installation of the boiler may be so limited that only one boiler can be installed. This condition arises with old plants and buildings,

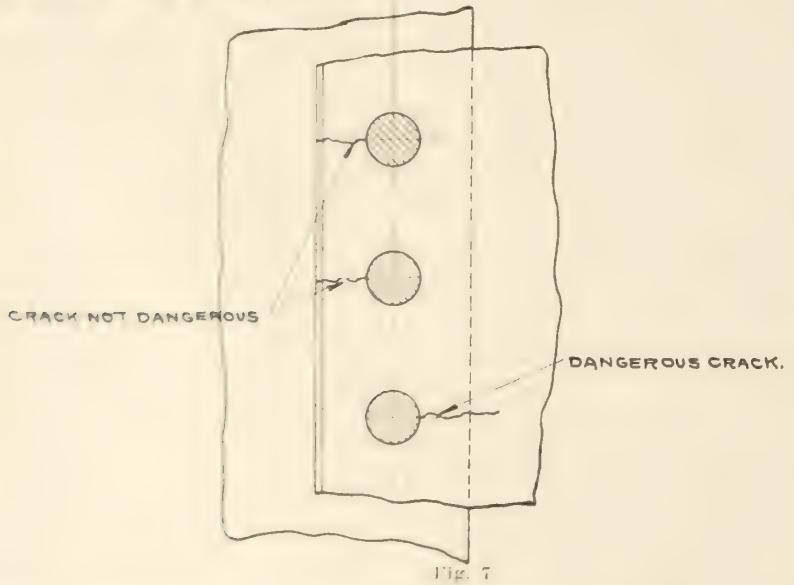


Fig. 7

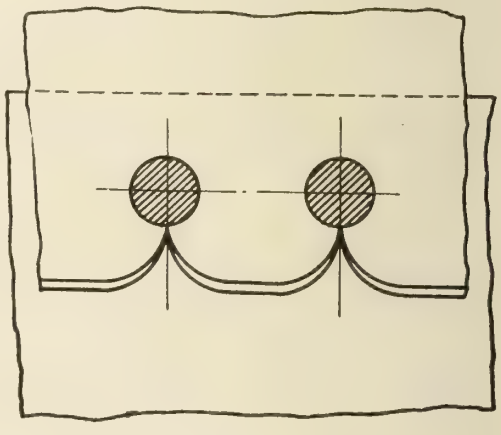


Fig. 8.

and though there may be a desire on the part of both the boiler designer and the purchaser to install two small boilers instead of one large boiler, or to install the regular boiler of a given capacity and an extra boiler of like capacity, it may be impossible, due to the limited space and none other can be secured, to install two boilers.

The length and the diameter of a boiler is sometimes a mere matter of choice. Other times the designer must consider the space allotted for the boiler. Perhaps it is the desire to install a 66 inch by 16 feet boiler, but the limited space will require the length to be limited to 14 feet. In this case it would necessitate increasing the diameter, or in lieu of the 66 inch by 16 feet boiler there would ordinarily be installed a 72 inch by 14 feet boiler.

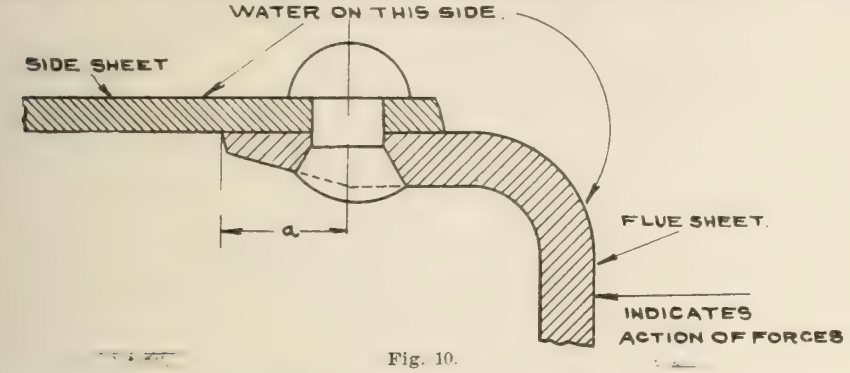


Fig. 10.

From these remarks it will be seen that the steam pressure per square inch and the horse-power are not the only items to consider. This was forcibly brought home to a certain party a few years ago, who needing a boiler at one of his plants and having an extra boiler at another plant several hundred miles away, shipped the extra boiler to supply the want at the first plant, only to find out after the arrival of the boiler that its length was too great, and to install same would necessitate changes in the boiler room involving an expense nearly as great—and perhaps as great—as purchasing a new boiler of proper length and diameter.

Shell Thickness Increases with Diameter

(9) Increasing the diameter of a boiler means an increase in the force acting upon the longitudinal plane. For instance: The force acting on the longitudinal plane of a 66 inch by 16 ft. boiler will be with 100 pounds pressure per square inch as follows:

66 x 192 x 100=1,267,200 pounds.

With a 72 in. by 16 ft. boiler, same pressure per square inch as in the foregoing example, the total load on the longitudinal plane will be:

72 x 192 x 100=1,382,400 pounds.

Thus, 1,382,400—1,267,200=115,200 pounds difference.

A greater force acting on the longitudinal plane necessitates the use of a heavier plate, otherwise a reduction in the allowable working pressure. It is to be assumed, however, that the efficiency of the riveted longitudinal seam is alike in both the above examples.

In considering the diameter of the boiler and the thickness of the shell plate, it is necessary to consider the efficiency of the longitudinal seam. For instance: The allowable working pressure on a 66 inch by 16 ft. boiler, plate 60,000 tensile strength and 7-16 in. in thickness, factor of safety of 5, efficiency of longitudinal seam 70 per cent., will be:

$$\frac{60{,}000 \times .70 \times .875}{66 \times 5} = 114 \text{ pounds.}$$

Now, a 72 in. by 16 ft. boiler, same as the above in regards to tensile strength, thickness of plate, factor of safety, but

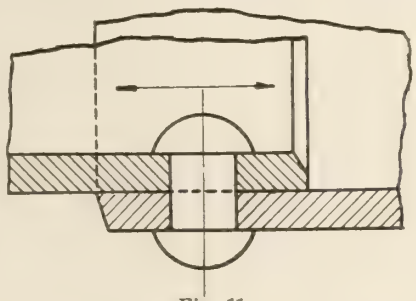


Fig. 11.

with a longitudinal seam having an efficiency of 80 per cent., will be allowed:

$$\frac{60{,}000 \times .80 \times .875}{72 \times 5} = 113 \text{ pounds}$$

Attention at this time is directed to the fact that the rules and regulations of all sections are not alike. The most of authorities give credit for the actual efficiency of the longitudinal seam, but if the above 72 in. by 16 ft. with the longitudinal seam of 80 per cent., was constructed under the Rules and Regulations, Part 11, for Marine Boilers, the maximum efficiency allowed would be only 70 per cent., irrespective of how many per cent. above this point the efficiency of the longitudinal seam computes.

Assuming the horse-power of a 66 in. by 16 ft. boiler to be the same as the horse-power of a 72 in. by 14 ft. boiler—

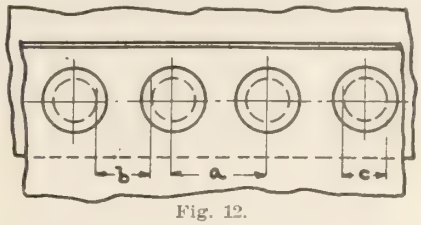


Fig. 12.

and many boiler manufacturers have them so rated—the 66 in. by 16 ft. boiler would be cheaper as to first costs and ordinarily would be a better steamer than the 72 in. by 14 ft. boiler; and being a better steamer would not consume as much fuel.

The chief reason why the 72 in. by 14 ft. boiler would cost as much and perhaps more than a 66 in. by 16 ft. boiler, is due to the fact that the former will ordinarily be constructed with a shell plate at least 1-16 inch heavier than the latter; also, the former boiler will require more tubes than the latter, and a little more work in the way of drilling flue holes, rolling flues, etc. The total costs of the respective boilers will not, however, be a great differential.

The 66 in. by 16 ft. boiler with a lighter plate than the 72 in. by 14 ft. boiler will be a freer or better steamer as the lighter plate will permit the transmission of heat to the water within the boiler more readily than the heavier plate.

The question has been asked more than once as to why Marine Boilers are constructed ten feet and more in diameter, while tubular boilers are rarely made greater in diameter than seven feet. The reason why Marine Boilers can be made large, having shell plates from one in. to one and one-half in. in thickness, is due to the fact that the shell plates are not in contact with the flames and hot gases.

The better part, one-half or more, of the shell of a tubular boiler is in con-

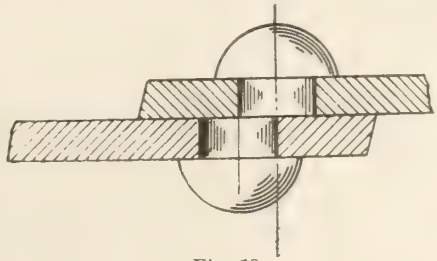


Fig. 13.

tact with the flames and hot gases, and is a part of the heating surface of the boiler. The thicker the plate the more difficult to transmit the heat through the plate to the water; hence, for this reason alone the shell plates of a tubular boil cannot be too thick.

Fire-Cracks.

(10) The heavier the plate the more liable it is to become overheated. This is especially true if foreign substances are allowed to adhere to the plate. Frequently the plate of the girth seams of a tubular boiler crack from the rivet hole

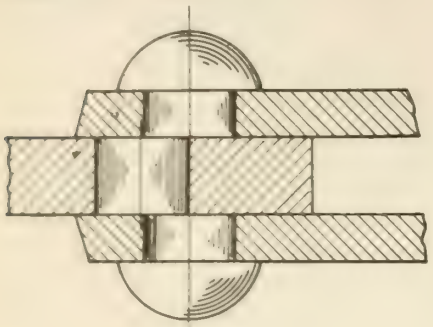


Fig. 14.

to the edge of the plate, as shown in Fig. 7, which is spoken of as fire-cracks.

This is due to the plate only being indirectly cooled by the water within the boiler; hence, it becomes semi-overheated, setting up stresses which crack the plate. The cracks are not serious—that is, dangerous, unless there are many such cracks. If, however, the crack extends into the solid plate, then take steps at once to prevent the crack from ex-

The girth seam of a tubular boiler directly over the bridge wall, as shown in Fig. 6, usually receives the impinging flame and due to the double thickness of metal, as well as the rivet heads, the metal at this point is many degrees hotter than at other points, resulting in fire-cracks.

Fire-cracks are frequently calked over and remain steam-tight. Sometimes they become troublesome and are taken care of by chipping out and calking, as shown in Fig. 8. Of late some manufacturers, who have adopted the two-course tubular boiler type of construction, are now driving the rivets in the lower part of the girth seam as shown in Fig. 9. This, however, they are limiting to just the girth seam over the bridge wall and about two feet up on each side of the boiler. The object of this is to have as little metal as possible cooled indirectly by the water within the boiler.

It is possible for the boiler designer with some types of boilers to design the boiler lines to prevent undue cracking of the plate from the rivet holes to the

locomotive type boilers. The practice is to bevel the door sheet and the flue sheet, especially the latter, for it is the in the manner shown in Fig. 10.

the rivets driven with an oval countersunk head on the side in contact with the flames and hot gases. The beveling of the plate and the installation of the rivets with oval head is for the purpose of having as little metal as possible indirectly cooled by the water within the boiler.

Such a practice is applicable with the furnace of the locomotive type boiler, for the force acting on the furnace acts as indicated by arrow, Fig. 10, and thus the plate from the centre of the rivet hole to the edge of the plate has no force acting upon it, while the plate from the centre of the rivet hole to the edge of the plate of the girth seam of a tubular, the same being indicated in Fig. 11, has to resist the force acting upon the transverse plane of the vessel.

The distance from the centre of the rivet hole to the edge of the plate with the girth seam of a tubular boiler should be one and one-half times the diameter of the rivet hole, while the distance a, Fig. 10, can be considerably less—usually about 1 1-8 times the diameter of

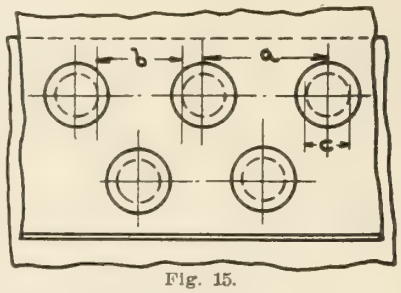


Fig. 15.

the rivet hole—and, because of the action of the force as described.

RIVETED JOINTS.

Modes of Failure.

(11) To figure strength or efficiency of a riveted joint would appear to be a simple matter upon first thought—and it is a simple matter, yet but few operating engineers are able to compute the respective parts of a riveted joint.

Some authorities have certain constants in the formula in regards to the material composing either the rivet, or the plate; also, for punched and drilled holes, but these matters will be treated separately, the purport at this time being to explain the underlying or fundamental principles of designing and computing a riveted joint.

The solid plate of the vessel, regardless of its thickness and its tensile strength, is rated at 100 per cent. The efficiency of the riveted joint compared to the solid plate is determined by computing each part of the riveted joint, adding together the strength of such parts as jointly resist the force acting upon the riveted joint.

In Fig. 12 is shown a single-riveted lap joint, which is the weakest of the several forms of riveted joints, and which type of riveted joint is used in the girth seam of tubular boilers. The distance a represents the distance from centre to centre of the rivet holes, and is called the PITCH. The distance b represents the distance from the edge of the rivet hole to the adjoining rivet hole, and is called the NET-SECTION OF PLATE. The distance c represents the diameter of the rivet hole installed into the plate, and thus the distance b and c are equal in length to the distance a.

The distance a, in this instance, is both the maximum and minimum pitch, and the distance b is both the maximum and minimum net section of plate. This, however, is not the case with all types of riveted joints, which will be seen later on. There should be a uniformity of pitch with both the maximum and minimum pitches, with such exceptions as will hereinafter be brought out.

If the rivets are arranged with uniformity in the respective rows, then the strength of one section will be the same as all like sections; in consequence the pitch a, with the single riveted lap joint may be considered a whole unit, or 100 per cent.

The installation of rivet holes into the plate will weaken the plate at that particular point, and the extent depends upon the size of the rivet hole installed and the pitch of the rivet holes. Thus, if the pitch a, Fig. 12, is 2 inches and the diameter of the rivet hole c is ¾ inch, then the net section of plate b is:

$$2-\tfrac{3}{4}=1\tfrac{1}{4} \text{ inch.}$$

The efficiency of the net section of plate is then found by comparing the

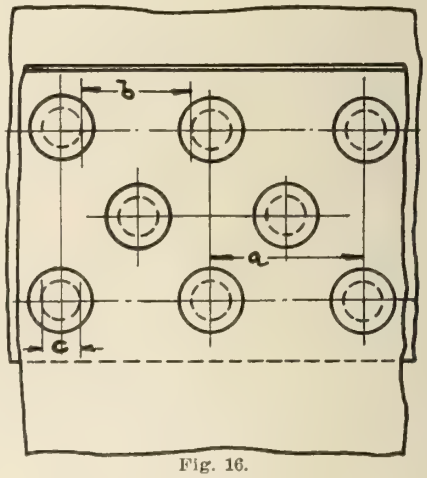


Fig. 16.

strength of the net section of plate with the solid plate, or:

$$\frac{1\tfrac{1}{4} \times 100}{2} = 62.5 \text{ per cent.}$$

This, however, is merely considering the efficiency of the net section of plate,

and, as will be noted, the thickness of the plate and its tensile strength have not been considered. The efficiency of the riveted joint has not been found, for the same force which acts upon the net sections of plate also acts upon the rivets, and the strength of the latter must be ascertained, and in this instance, if weaker than the net section of plate, then the efficiency of the riveted joint, Fig. 12, will be decided by the rivets, otherwise by the net section of plate.

Before the efficiency of the rivet compared to the strength of the solid plate can be ascertained, the latter must first be known; also, the shearing strength of the rivet per square inch.

The strength of the solid plate is found by multiplication. The tensile strength of the plate must be known, as well as the thickness of the plate and the rivet pitch. Assuming plate to be 60,000 tensile strength, then the strength of the solid plate, 2 inch pitch as shown in Fig. 12, plate 3-8 inch in thickness, will be:

60,000 x 2 x .375=45,000 pounds.

To determine the shearing strength of the rivet, it is necessary to know the diameter of the rivet, whether in single or double shear, whether a steel or iron rivet, and the shearing strength allowed per square inch. With a lap joint as shown in Fig. 12, it is only necessary to sever the rivet as shown in Fig. 13 to separate the plates, the rivet being in single shear as it is severed at only one point, while a rivet in double shear is severed at two points as shown in Fig. 14.

It would seem that as the rivet in double shear is severed in two places the force required would be twice as great as the force required to sever the rivet at on point as shown in Fig. 13. However, tests have brought out that it does not require twice the force of single shear to double shear a rivet. As a general proposition the shearing strength of a rivet in double shear is 1.85 times the shearing strength of a rivet in single shear.

The shearing strength per square inch of a rivet in single shear varies, being greater with steel rivets than with iron rivets. Some authorities allowed for steel rivets in single shear a shearing strength of 45,000 pounds per square inch, and for iron rivets a shearing strength of 42,000 pounds per square inch. These, however, are the maximum values; the majority of authorities allow less.

Merely for the sake of illustrating the principle of designing riveted joints, the foregoing values will be assumed as standard and will be used hereafter in all calculations. Then, if steel rivets are used, the efficiency of the rivets of the single-riveted lap joint, Fig. 12, can be determined by the following formula.

Where:

A=Area of rivet in inches.
B=Number of rivets in shear.
E=Efficiency of rivets.
P=Pitch of rivets in inches.
T=Thickness of plate in inches.
TS=Tensile strength of plate in lbs.
SS=Shearing strength of rivets in lbs

$$\frac{A \times B \times SS}{TS \times T \times P} = E$$

Then substituting values, the efficiency of the rivet is:

$$\frac{.44179 \times 1 \times 45.000}{60,000 \times .375 \times 2} = 44 \text{ efficiency.}$$

These calculations show that the efficiency of the joint is 44 per cent., while the efficiency of the net section of plate is 62.5 per cent. By using a larger rivet (the constant .44179 in the above calculations is the area of a ¾ inch rivet) the shearing strength of the rivet will increase, and a larger rivet with the same pitch as formerly will reduce the length of the net section of plate and its efficiency accordingly.

The double riveted lap joint as shown in Fig. 15 is stronger than the single riveted lap joint, as the pitch a with a double riveted lap joint can be made greater than with a single riveted lap joint, and there being two rows of rivets, the rivet shearing strength is likewise increased.

The triple riveted lap joint as shown in Fig. 16 is stronger than the double riveted joint for the same reasons as given above. The addition of additional rows of rivets not only increases the rivet shearing strength, but permits increasing the pitch of the rivets, thereby increasing the net section of plate and its efficiency.

JOINING CANADA'S NAVY.

Montreal's first representatives in the Canadian navy comprise S. N. de Quetteville and F. H. Jefferson, both of whom have recently been appointed engineer sub-lieutenants on H.M.C.S. the Niobe.

Mr. de Quetteville was born at St. Helier, Jersey, Channel Islands, in 1888. He received his education at the Jersey Modern College, and his technical training at the engineering works of the South Eastern and Chatham Railway Co., at Ashford, Eng., also at Ashford Technical College. Since coming to Montreal Mr. de Quetteville has been employed in the offices of Darling Bros., as a mechanical draughtsmen. He is a student member of the Canadian Institute of Civil Engineers.

Mr. Jefferson was born at Hastings, England, in 1886. He received his education at Auckland Grammar School, Auckland, New Zealand, and his technical training with Messrs. Philip & Sons, Admiralty contractors, Dartmouth, Eng.; at H. M. Dockyard at Devonport and at the Devonport Technical College. Since coming to Montreal Mr. Jefferson has been employed as a mechanical draughtsman in the offices of Darling Bros. He is also a student member of the Canadian Society of Civil Engineers, Montreal.

MINERAL VS. TALLOW LUBRICATING GREASES.

There are two types of greases in general commercial use—mineral greases consisting of mineral oils thickened with varying percentages of lime soap and melting at from 150 to 200 deg. F., and tallow greases, consisting mainly of hard vegetable or animal fat, a little mineral oil and a small percentage of potash soap (melting point, 75 to 125 deg. F.). Three grades of Albany grease, hard, medium and soft, were selected and matched by mineral greases intended for the same classes of work. These were tested on three-hour runs in a large Olsen testing machine, running at 320 r. p.m., under bearing pressures ranging from 86 to 431 lb. per sq. in. of projected area. The average co-efficient of friction for the three grades of mineral grease at all the pressures used in the tests was found to be 0.0106; and similarly, for the tallow greases, 0.0093. This is consistent with the supposition that greases with a low melting point and a low soap content should be more efficient.—Horace W. Gillett, in American Machinist.

A draftsman seldom has the patience to erase an ink line from tracing cloth properly. If the eraser is operated with too much pressure, the cloth is marred. The proper method is to operate the eraser with a light, but quick, motion. Recently, an electrically-driven eraser has been invented, consisting of a small motor provided with a flexible shaft which carries a circular eraser at its outer end. In order to clean the eraser of particles of ink which it picks up, a cleaning rubber is provided, which bears lightly against the erasing rubber. A device of this sort should be sufficient to meet the requirements of a large drafting room.

Wherever there is a line shaft attention should be given to keeping the shaft clean. Aside from other considerations an accumulation of dust and grease on the shaft is an added fire hazard. The easiest way to prevent dirt and dust from collecting is to provide each shaft with a steel ring between each pair of bearings. This will travel back and forth preventing any deposit or accumulation of dust or oil.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV FEBRUARY, 1911 No. 2

PEAT AS FUEL.

In the December issue we published an editorial on "Peat as Fuel," which has evoked considerable discussion. On account of the interest taken in the subject we published a description of the Government fuel testing station at Ottawa, and in an early issue we will give further data on the subject which will interest every user of fuel.

Two or three of the figures have been criticised by L. B. Lincoln, vice-president of the American and Canadian Peat Societies and associate editor of the American Peat Journal. The vital points treated in Mr. Lincoln's letters are cost of labor and plant, output and calorific value of peat.

It is only fair to state that Mr. Lincoln is interested in peat plants and machines, having machines installed at Farnham, P.Q.; Whitemouth, Man.; Argentine; Mexico, etc. It would therefore be a good advertisement for the peat industry if the figures quoted in December are correct, but even accepting Mr. Lincoln's figures, we can see a big future for the peat industry in Canada and believe the Department of Mines, Ottawa, and Eugene Haanel, the director, are engaged in an excellent work in bringing to the front Canada's hidden resources and their possibilities.

There are different qualities of peat and Mystrom's report quoted in our editorial gives 1.8 tons peat equal to 1 ton of best anthracite. Mr. Lincoln states that of some peat it will take 2 tons to equal 1 ton of coal while some peat has a calorific value that will compare as 1.4 tons peat to 1 ton coal.

Mr. Lincoln states that our cost figures are too low for commercial peat and states that a commercial plant is being erected in Manitoba at a cost of $25,000, this being the cost of an average plant. In connection with briquetting peat Mr. Lincoln says: "I must decidedly urge abandoning the idea of making peat into briquettes (peat bricks), and I can assure you that Dr. Haanel, the director of mines, who, in fact, is the father of the successful peat industry in Canada, is of the same opinion. All the failures which have followed closely the peat industry in the Dominion are due, almost without exception, to the idea of briquetting peat." Those interested in the peat industry should investigate this matter carefully and there is an opening for the Department of Mines for some additional research work and the publishing of additional information.

Mr. Lincoln states that so many errors have been made in the peat industry that for a long time the peat industry was more than dormant and now, when by the strong endeavors being put forward, the country is waking up to the resources in peat, great care must be taken not to let any error creep in and injure the peat industry.

Dr. Haanel in a recent address before the Canadian Club, Toronto, pointed out that the known peat bogs in the central provinces of Canada cover 12,000 square miles with an average depth of 6 feet.

One square mile of peat bog, six feet deep, said Dr. Haanel, would produce 774,400 tons of peat fuel, containing twenty-five per cent. of moisture. The 12,000 square miles would therefore contain 9,292,800,000 tons of peat, equal in fuel value to about 5,306,074,000tons of good coal. Such an amount would supply 5,306,076 families for 100 years, assuming each family to consume an equivalent of ten tons of the best anthracite per annum.

For the manufacture of peat fuel on a large scale, say 20,000 to 30,000 tons annually, mechanical excavators, spreaders and cutters should replace manual labor, said Dr. Haanel, and within the last two years Lieutenant Ekelund had constructed an excavator to which the roots and stumps found in most bogs were no impediment. By the use of his machinery the cost per ton on the annual output of 30,000 tons had been reduced to ninety-two cents in the shed. Ekelund, however, starting from air-dried machine peat with forty to fifty per cent. of moisture, carried his process further to obtain a product in the form of powder with ten per cent. of moisture, the heating effect of which pound for pound, was said to be equivalent to the best English bituminous coal.

This peat powder was admirably adapted for industrial purposes, being a magnificent fuel for steam-raising. Blown under a boiler it burns with a long, hot, smokeless flame, leaving no unburnt particles. The flame is readily regulated, extinguished and relighted at pleasure. The firing is automatic, and it gasifies instantly and completely, leaving no soot or clinkers, but only a soft, friable ash, conveniently removed by a suction fan. The fuel is specially adapted to the cement, glass and clay industries

FERRANTI'S VISION.

S. Z. Ferranti in his presidential address before the Institution of Electrical Engineers in England recently, deviated from precedent on such occasions, by throwing back the curtain from the future, instead of dwelling on the present and past, to unfold a new civilization by the engineer.

The consensus of opinion not only expresses the utmost admiration for the wonderful vision presented, but is satisfied that the ideas are inextravagant, and well within the region of not-far-distant fulfillment.

People are still alive who lived when there were neither railways nor telegraphs, and there are children still at school who were born before the advent of wireless telegraphy, automobiles, and flying machines. In the face of such progress, we have no reason to be fearful of

the future, but to be confident of a still greater achievement.

From a foundation statement, that from many million tons of coal burned annually, less than 10 per cent. efficiency is obtained, he predicts, by the adoption of a steam-gas-turbine, in which steam will be used in a high state of gas, at high temperature throughout the process of conversion into work, an increase to 25 per cent. efficiency from the coal.

This effect however, he makes become cause of much greater and more far-reaching effects. He sees the burden of toil lifted, more leisure to the toiler, the reduction of cost of necessaries of existence, the abolition of dirt from the atmosphere and our homes, the fertilization of our fields; in a word, an emancipation undreamed of by socialism of any stamp, by this substitution of steam for human energy, steel for muscle, and the engineer's assertion of himself as a power in social reform.

The address is believed to have been most opportune, and a much needed fillip has been given to individual effort and research. A genuine public interest has been aroused, which will materially assist a realization; but to engineers more particularly, aside from the substance of the address, there is incentive to give more scope to the imaginative faculties, and to study to cultivate them, because likely to lead to some useful concrete form development.

Mr. Ferranti estimates that the scheme he proposes would enable electricity to be supplied at an average cost of one-fourth of a cent per kilowatt-hour, making it thereby, only a matter of time, for all cooking and heating to be done by that means.

Science is taking long strides; is the forerunner of industry, and requires keeping pace to, by the latter. Ferranti's vision is the outcome of many years of close application to his subject. It is an aquisition to our knowledge of what the future has in store for this old world, and serves to direct our ideas and schemes into a well defined line of action. Engineers like other mortals, wander aimlessly for want of leadership, want of advice and want of purpose. They are more or less out of the current of progress, and are living on the pride of past achievement, or in the remorse of some past failure.

You may not have the vision of a Ferranti, and may not be alert enough to see it just as he does, even when directed to it. You may, however, have at the opening of this New Year a vision of what you may attain to personally, and if you will but strive to it, you will aid very materially, the early ultimate consummation of the Ferranti vision, and by so doing aid and bring credit on yourself.

OBEY THE BOILER INSPECTOR.

A boiler explosion occurred recently at the plant of the Morehead Lake Ice Co., Pittsfield, Mass., killing 17 men and injuring that many more. The boiler was inspected in the spring of 1910 and the working pressure fixed at 70 pounds per sq. in. Certain changes were ordered to be made by the inspector, and, after the company had notified the inspector that these changes had been made, the usual certificate was granted.

One of the changes ordered by the inspector was the installation of a new safety valve, but it was brought out in the inquest that the inspector's orders relative to the new safety valve were violated in three respects. The order to have a bushing and pipe removed so that there would be a full-sized discharge was not obeyed; the valve was set at a pressure of 80 lbs. when only 70 pounds was authorized, and a 3½-inch valve was used when a 2-inch valve had been specified.

The boiler plate was afterwards tested and showed 47,000 pounds per square inch tensile strength with the grain and 41,000 pds. per square inch across the grain. At the inquest witnesses said the engineer could raise only 35 or 10 pounds steam on the day of the explosion, but the day previous to it the engineer had overhauled the steam gauge; then, relying upon it to be accurate, he screwed down the safety valve, an inspection of which, after the explosion, showing that this had been done. Apparently then, excessive pressure, not shown by the steam guage, was put on the boiler plate. There was no evidence to show that the boiler was unfit to sustain the working pressure of 70 pounds, allowed by the inspector.

Another unfortunate feature was that the boiler was in charge of a regularly licensed engineer. Those who object to more stringent regulations in some of the Canadian provinces should have their objections answered by above illustration. Stationary engineering societies generally recognize that the fair name of their profession depends on the various examining boards of the different provinces insisting on the standard of the profession being maintained and are to be commended on the stand they have taken, and the assistance given in the enforcement of the laws.

ONTARIO ENGINEERS' LICENSE LAW.

An act respecting the Board of Stationary Engineers has been given a first reading in the Ontario Legislature. The bill is really an amendment of the act respecting stationary engineers with one or two exceptions. The subject matter has been re-arranged and paragraph 6 referring to the granting of certificates only has been dropped in the new act.

Paragraph 14 of the new act is new and reads as follows:

14.—(1) Any member of the Board, on presentation of authority in writing signed by the minister may enter any premises wherein he has reason to believe there is a steam plant, and make such inspection as may be necessary to determine whether the provisions of this Act are being complied with.

(2) Any person who interferes with or obstructs a member of the Board in the exercise of the powers conferred on him shall incur a penalty not exceeding $100, recoverable under The Ontario Summary Convictions Act.

TOPICS OF THE MONTH.

A well lighted power plant or factory is more likely to be kept clean than a dark one.

* * *

The United States Senate on January 10 passed the Locomotive Boiler Inspection Bill, which has been pending before Congress for a long time. This new bureau will very shortly be created, and the President will appoint a chief inspector and two assistant chief inspectors, who are to have charge of the bureau and the fifty practical boiler inspectors. There is a move on foot to have technical men placed in the positions as chief inspector and assistant chief inspectors. A candidate for the chief inspectorship, who is being put forward by the International Boiler Makers and Iron Ship Builders, is H. S. Jeffery, now well known to Canadians through his articles on Boiler Design, etc., appearing in The Power House. Mr. Jeffery has had sixteen years' experience designing, constructing, repairing and inspecting boilers and is well qualified for the position.

Power Plant Troubles, Happenings and Improvements

By Blackrock

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

A CORRECTION.

The article in this section of our January issue page 7, entitled "Grease in Steam Boilers," is to be taken as completed on that page, and the half column on upper left hand side of page 8 is to be taken as a continuation of the article on "Boiler Inspection," it having been inadvertently misplaced.—Editors.

A NEW FUEL.

Sudd, as the name by which the new fuel is known by, consists mainly of papyrus, a species of reed from which the ancients made a material for writing upon, and grows abundantly on the upper reaches of the White Nile, covering an area estimated at 35,000 square miles.

Lord Cromer once suggested that this Nile weed as he called it, might make a cheap and economical fuel, having in view the fact that in Khartoum, coal costs $16 per ton, and wood little less if any.

An Anglo-German syndicate has been formed to convert and manufacture the material into briquettes, the process, it is believed, being possible of attainment without the addition of any foreign binding material. The Soudan Government are likely to grant a 15 years' monopoly to the syndicate.

Tests recently made in Germany in the presence of representatives of British and German admiralties, determine the heating value of "Sudd" as 7400 B.T.U. per pound. Boiler tests showed an evaporation of 2.78 pounds of water per pound of fuel against 2 pounds of water per pound of best German known fuel.

With boiler grates specially adapted for the purpose and which were not so for the tests made, an equivalent evaporation of 4.8 pounds of water per pound of fuel is attainable.

The market will not probably extend beyond Egyptian necessities, the demands of which with respect to locomotives, steamboats and factories is expected to yield profitable returns to those interested.

Of prime importance, however, is the turning of a hitherto well nigh useless product of nature into a valuable service, and suggesting it may be in other countries like possibilities for presently useless natural products.

YOUR ENGINE AND BOILER ROOM.

My subject is of direct personal interest to the owner and engineer of every power plant and the intention is to, if possible, awaken to a conscious realization, what is in a majority of cases an utterly careless and indifferent attitude to the engine and boiler rooms under their care.

To some it may seem that there is not much involved and that other and more pressing questions come for adjustment first. I want to ask is your engine and boiler room all it might be, all it should be, and do each of you realize that they are at present what you have made them.

Time was, not so long ago and may be to some extent still, when the engine and boiler rooms were the meanest places in all the factory, being located in some out-of-the-way corner where as little could be seen of them as possible and then only, when something went wrong involving a shut-down. The engineer was an all-round roustabout who shovelled coal all week, tinkered around the boilers, engines and pumps all day Sunday, profanely eloquent against everybody who perchance supplied, installed and owned the outfit.

The introduction of large electric power stations, private heating and power plants for departmental stores, hotels, breweries, packing and cold storage houses has done much to improve the condition of affairs. The reason not far to seek, being none other than the timely recognition by shrewd business men of the foolishness of placing expensive and delicate machinery in a back number engine room. They recognized that reliability of operation could only be had with the generating pulse in the limelight, if they were to secure a profitable return on their investment.

It has been said that a view of the engine room gives a fair indication of the engineer in charge, and with this most people will agree. The engine room in which the distinct knocks tell of each revolution made, the hiss of steam from leaky joints, the tools, oil and water lying all over the floor, the windows cobwebbed and dirty, indicates in a fairly reliable way what the engineer is in action and appearance without seeing him. Just as surely do we get a true picture of our man when smoothness and easy running characterizes the engine, when the floors are clean and tidy, the various fittings polished, escaping steam, loose oil and water are conspicuous by their absence, and everything is kept in its appointed and convenient place against emergencies.

It is not necessary that tiled floors, white enamelled brick wall interiors and other trimmings of a superior class be a part of the equipment towards cleanliness, system and order, but it is necessary that every engineer should see to it that, the plant of which he has charge, is kept in such manner that it does not reflect injuriously on him and his work, in the eyes of his present or of a prospective employer, and these latter should see to it that an engineer and his engine room do not impress unfavorably an outside estimation of themselves. This may be prevented by their insisting on cleanliness and tidiness in everything pertaining to the power plant, and their encouragement and recognition of the engineer doing so.

Carelessness again is antagonistic to the highest efficiency of operating being attained, and for this, if no other reason, all concerned should take a live interest.

Boiler rooms suffer more perhaps than do engine rooms, due largely to a poor layout in the matter of access and light for inspection, and being thus under a cloud as it were, don't draw attention or criticism to the same extent. Not enough interest is taken in them by engineers, in fact their absence from them is marked. This should not be so. Although you have graduated from the coal shovel, and are naturally proud of your achievement in having left it behind, have a care still for the boiler room.

To operating engineers I would say give your engine and boiler rooms the best of your hand and head and show administrative ability, as much depends on and is expected of you.

To employers I would say keep a sharp eye on slovenly kept engine and boiler rooms, as they usually mean waste and inefficiency, features you do not want.

Progress and Development of Hydraulic Engineering

No Apology is Necessary for Our Featuring Hydraulic Engineering in Canada. This Country Lends Itself Naturally to a Development and Progress Along the Lines of Every Description of Water Power Equipment, and the Idea in This Particular Section of Our Paper is to Make Known What is Doing and Who is Doing it Throughout the Whole Field.

TURBINE WATER WHEELS.

THAT Canadian manufacturers are not far from the forefront in turbine water wheel production is evidenced by the success attending the firm of Chas. Barber and Sons, Meaford, Ont.

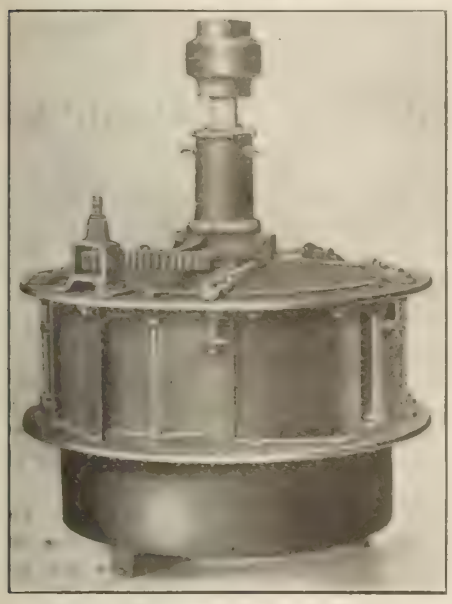


Fig. 1. Standard Vertical Turbine.

The merits of their Canadian turbine water wheel are known throughout the Dominion, as witnessed by the numerous successful installations made by them in every Province; yet in spite of the high-grade of efficiency and success already attained, they are aiming at higher still, with which end in view, their chief engineer, Thomas Barber, is taking a post-graduate course at the school of practical science, Toronto, special study being given to the hydraulic section.

Recognizing an increasing demand for expert services in their business, Barber & Sons are preparing themselves to meet it. The year 1910 brought success and 1911 shows signs already of eclipsing it.

During last year they installed among others, the following plants: Erindale Power Co., Limited, of West Toronto, at Erindale; The Slingsby Mfg. Co., Limited, Brantford; The Paris Wincey Mill Co., Limited, Paris, Ont.; The C. Turnbull Co., of Galt, Limited, Galt, Ont.; The Miner Rubber Co., Granby, P.Q.; The Smith's Falls Electric Power Co., Ltd., Smith's Falls, Ont.; J. Rumble, Hillsdale, Ont.; W. E. Armstrong, Waweig, N.B.; Wm. and R. A. Pryne, Brussels, Ont.; The Delhi Light and Power Co., Limited, Delhi, Ont.; John Fisher & Sons, Limited, Dundas, Ont.

A brief description of their specialty will doubtless be of interest. Fig. 1 shows their latest design of complete standard vertical turbine; Fig. 2, their standard 22-inch runner; Fig. 3, their standard gate mechanism.

The number of vanes in the 22-inch standard runner is 10, and this varies from 8 in the 12-inch wheels to 15 in the 70-inch wheels. A distinguishing feature of the runner is that it is a one-piece casting, smooth and strong, a striking exemplification of the molder's art.

To reduce wear to a minimum the various bearings are phosphor bronze bushed. The full diameter type runner gives a highly effective combination of impact and reaction, ensuring economy and imparting to the power steadiness and stiffness.

The gates, as will be seen in Fig. 3, are alternately moving and stationary, the former being balanced on a heavy steel pivot pin fully equipped for adjustment. This pivoted type of gate gives the highest efficiency at all points of gate opening, and has the following advantages:

1 It gives the same number of openings as though all the gates were moved.

2 It gives constant direction of water at right angles to receiving vanes of runner.

3 Stability of wheel case, supported by wide bearing faces instead of small pillars which only obstruct the flow.

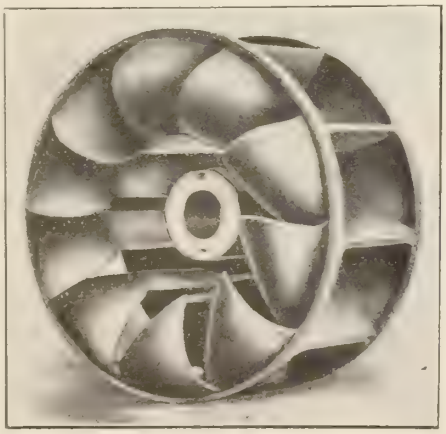


Fig. 2.—Standard Runner.

4 Moving half the gates only requires half the power to operate them, thereby eliminating considerable wear.

5 The stationary gates form a definite face on each side of the moving gates, against which they are set absolutely tight. Further, they can be reset in a few minutes by a skilled mechanic.

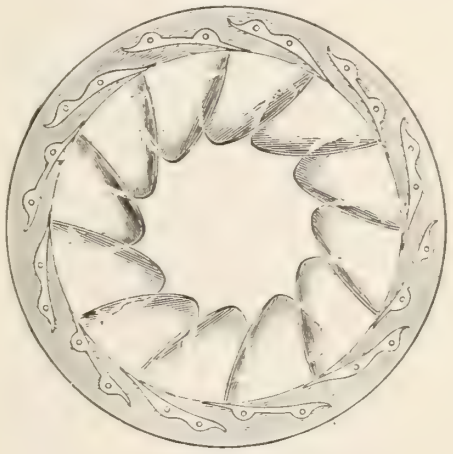


Fig. 3.—Standard Gate Mechanism.

The gate, as will be noted from the above, is necessarily easy of control, absolutely light, simple, strong, durable and easily governed under either hand or machine operation.

This Canadian turbine is what is known as the full diameter or Swiss type and will start its load into motion instantly without excess gate opening or assistance. It is suitable for low heads, and with full gate and no load does not run wild and uses less water than when loaded.

It may be run 10 per cent. above or below the rated speed with highly satisfactory results and small drop in efficiency.

The head may be varied as much as 30 per cent and the set speed maintained when not overloaded to start. The runner is not encumbered with vanes and there is no danger from choking.

UNDEVELOPED WATERPOWERS.

L. V. Rorke, inspector of surveys for the Ontario government's department of lands, forests and mines, has compiled statistics that show that there is 2,000,000 horsepower on the northern slope towards Hudson bay, within a distance of 100 miles from the route of the National Transcontinental railway, which would be amply sufficient for the electrification of this important section of the Canadian national railway line.

The largest of the rivers, the power of which can be used, are the Abitibi, the Mattagama and the Missanabi, tribut-

aries of the Moose river, the Kaquinaka-sand and Ogoki rivers flowing into the Albany and the Winnipeg and English rivers.

On the Mattagami river there are five important waterfalls, the largest being the Long Rapids falls, with a natural head of 150 feet and a minimum flow of 5,008 cubic feet per second, which would give, under proper drainage, over 200,000 horsepower for 24 hours. On the same river the Grand Rapids, with a fall of 100 feet, is capable of developing 150,000 horsepower under drainage control, and the Little Long Falls with a 50-foot head, would develop 108,000 horsepower. The 12 other falls on the river range from 56,800 horsepower down to 4,500 horse power.

On the Abitibi river there is a series of falls above New Post with a total of 100 feet and an estimated minimum flow of 4,000 cubic feet per second, yielding under drainage regulation 124,000 horsepower.

On the Missanabi river within the available area at Conjurer's Chute and Hell's Gate, there is a fall of 250 feet and a minimum flow of 2,600 feet per second, the minimum 24 hour horsepower would be 75,000 horsepower. The White Dog falls, on the Winnipeg river, with a head of 50 feet and a flow of 11,000 cubic feet per second, can develop 70,000 horsepower.

According to Mr. Rorke, the estimates which give an aggregate of 2,000,000 horsepower, are careful and conservative, and are based on surveys and measurements of the flow of water and the sustaining drainage area.

The North-West Association of Stationary Engineers

By J. E. Cullen

The Fifth Annual Convention was Marked by the Number of Excellent Instructive Papers Read Before the Gathering of Engineers and Discussed by Them. A Full Report of the Western Gathering.

THE Fifth Annual Convention of the Grand Lodge North-West Association Stationary Engineers, was held at Edmonton on December 27 and succeeding days. The convention was opened on the evening of December 27 with Grand Chief, Robt. Niven, of Lethbridge, in the chair, and with delegates from various parts of Alberta in attendance. The delegates' credentials were examined and reported upon by a committee. The Grand Chief then gave an opening address, in which he welcomed the delegates, and outlined the work of the association. The aims of the association are to educate and aid the members to become more efficient in their calling, and to thus maintain a higher standard among themselves. The session then adjourned to meet again at 10 o'clock next morning.

Executive Officers.

The following is the executive of the association for 1910: Grand Chief, Robt. Niven, Lethbridge; Grand Vice-Chief, F. A. McLean, Edmonton; Grand Secretary, E. H. Oliver, Calgary; Grand Treasurer, A. Cousins, Calgary; Grand Organizer, J. E. Cullen, Calgary; Grand Door Guard, J. E. Kelly, Edmonton.

At the morning session, December 28, the minutes of the Past Grand Lodge meeting were read and adopted. The question of a uniform boiler law of the Dominion was brought up and warmly discussed. Under the present conditions a man, be he ever so competent an engineer, is qualified only in his own province, was declared unsatisfactory, and unfair. As others had brought about legislation, standardizing their profession, it is hoped that a similar work can be accomplished for the en-

A letter was read from E. H. Oliver, tendering his resignation as Grand Secretary.

It was moved and seconded that the resignation of Bro. E. H. Oliver be accepted, and a vote of thanks tendered him for his service to the association for the last four years as Grand Secretary.

The afternoon session was taken up by visiting the Telephone Exchange, city power plant and Strathcona power plant.

Open Meeting.

The evening session was an open meeting of considerable interest to both the engineers and others. The programme was as follows: Chairman's opening address by G.C., R. Niven, Lethbridge; a paper by J. A. Stewart, Edmonton, on "Recent Practice in Refuse Disposal and Utilization Plants." Discussion on same. Address by J. E. Cullen, Calgary, "The Principles of the Association and the Duties of the Engineer Towards it;" a song by J. G. Fisk; a paper by Geo. Inglis, Edmonton, on "The Choice of a Boiler." Discussion. A paper by F. A. McLean, Edmonton, on "Combustion and Furnace Designs." Discussion. A paper by A. J. Latornell, B.A.Sc., A.M. Can. S.O.C. C.E., City Engineer, Edmonton, "Responsibility of an Engineer." The meeting was closed by singing God Save the King.

December 29. Session opened at 10 o'clock. Secretary - treasurer's and auditor's reports were received, and the association was found to be in a flourishing condition. General business was resumed, with a discussion on the Boiler Act, and amendments to the constitution and by-laws. The afternoon was taken up by visiting the various plants of the city.

New Officers.

The convention of the North-West Association of Stationary Engineers was brought to a close this morning, by the election of officers for the year 1911.

Grand Chief, Bro. R. Niven, Lethbridge; Vice-Chief, Bro. C. A. Defieux, Edmonton; Secretary, Bro. W. J. Cunningham, Calgary; Treasurer, Bro. J. E. Cullen, Calgary; Grand Organizer, Bro. J. A. Stewart, Edmonton; Grand Door Guard, Bro. J. Kelly, Edmonton.

After some discussion, Calgary was chosen as the place of meeting for the next convention, the date for which was fixed for November 7, 8 and 9, 1911.

A handsome watch fob and locket was presented to Bro. E. H. Oliver, of Calgary, retiring Grand Secretary, as a token of appreciation for the able manner in which he had filled that office for the last four years.

Business having been disposed of, two papers of a high order of interest were presented. The first was by Bro. W. J. Cunningham, the newly-appointed Grand Secretary, entitled "The Indicator; what it is, and its value to the Engineer." The second was by Bro. C. A. Defieux and was entitled "The Ambiguous Term Horse Power as Applied to boilers, and the Various Causes of Corrosion in Boilers." Bro. Defieux's paper was of exceptional interest, and was the subject of a lively discussion, in which a majority of the delegates present participated. The section of his paper which dealt with the care of boilers and the measures to be adopted to stay corrosion, was most prominent in the discussion, much valuable information being elicited from the experience of the several delegates, working under diverse conditions in various parts of the province. A hearty vote of thanks was tendered Bros. Cunningham and Defieux for their interesting papers. A vote of thanks was tendered the press, also to the members of Local No. 5, for the courtesies shown the delegates during the convention.

News of Societies

Officers of Engineering Societies and Current News of Associations

Societies and Personal.

Walter J. Sadler, who for the past fifteen years has been connected with the firm of Sadler & Haworth, Montreal, manufacturers of leather belting, has been taken into partnership.

* * *

The new club rooms of the Engineers' Club, 90-96 King St. West, Toronto, are now open and the writing, lounge, billiard, card and dining rooms are ready for use. The ticket system of payment has been adopted and tickets can be obtained from the secretary, R. B. Wolsey.

* * *

Geo. D. Leacock has been appointed traveling representative for the Packard Electric Co., for the territory of Ontario, from Kingston West to Sault Ste. Marie. His headquarters will be Toronto.

* * *

W. C. McGhie, chairman of the Ontario Stationary Engineers' Board is a very busy man as the following will show. He has been holding examinations for engineers besides speaking at many gatherings of engineers. On Jan. 16 he visited Collingwood; Guelph 17, Berlin 18, Stratford 19, Woodstock 20, Sarnia 23, Petrolia 24, Chatham 25, Windsor 26 and 27, Leamington 28, St. Thomas 31 and Feb. 1, and London 2, 3 and 4. On Feb. 15 he returns to London and on Feb. 22 he will address the Toronto International Union of Steam Engineers on the workings and enforcement of the Ontario Act.

* * *

The Ottawa branch of the Canadian Society of Civil Engineers held a dinner at the King George hotel on Feb. 1. A. A. Dion presided. The members who had attended the recent convention in Winnipeg gave reports, which were followed by an informal discussion.

* * *

At a meeting of the electrical section of Canadian Society of C.E., 413 Dorchester St., Montreal, Jan. 19, A. O. Austin read a paper on "The Development of Efficiency in High Tension Transmission Insulators" and illustrated it with lantern slides.

* * *

On Feb. 22 W. C. McGhie will address the International Union of Steam Engineers, No. 152, in the Labor Temple, Toronto.

The death of J. E. Schwitzer, chief engineer of the Canadian Pacific Railway, occurred Jan. 23 at the Royal Victoria hospital, Montreal. He was promoted only a few weeks ago from the position of assistant chief engineer at Winnipeg, and took pneumonia a day or two after his arrival at Montreal.

* * *

The engineering department of Fort William tendered a banquet to retiring engineer H. S. Hancock on Jan. 25. The following were present: H. S. Hancock, Jr., John Wilson, T. F. Dewar, A. Chapman, G. B. Astell, H. Dougherty, F. J. Moors, H. M. Woodehouse, George Pappin, W. J. Wrigly, S. C. Farquharson, C. B. Symes and W. H. Macaulay.

* * *

About fifty travelers, visitors and officials connected with the Montreal office of the Canadian Fairbanks Co., enjoyed their annual dinner recently. After the tables were cleared, matters connected with the various departments of the business were discussed informally, by the heads of the different departments.

DISTRICT AND SOCIETY NEWS.

Devoted to brief reports of the various engineering societies of the Dominion, notices of meetings, reading of papers, license examinations, personal grievances and individual experiences. An exchange whereby through district correspondence, close touch and helpful influence, a mutually educative interest may be aroused and maintained. The co-operation of professional and operating engineers individually and collectively, through the secretaries of the various societies, can do much towards making a feature of this section of our paper.

* * *

Jas. Whiteacre, late assistant superintendent of the Goldie & McCulloch Co.'s boiler works, Galt, has accepted the position of Superintendent of the boiler department of the John McDougall Caledonia Iron Works, Montreal.

* * *

Prof. C. R. Young, Toronto, read a paper on "Aesthetics in Bridge Design" before the C.S.C.E., Montreal, on Feb. 2.

R. C. Young, B.A.Sc., addressed the Civil and Architectural, Mining and Chemical sections of the Engineering Society of University of Toronto, recently on "Great Achievements in Bridge-building." He followed bridge-building from some of the still-existing primitive structures, entirely of wood and stones and of doubtful date, down to the most modern feats of engineering as exemplified by the steel and concrete bridges of recent years.

* * *

The Industrial Chemical Club at a recent meeting was addressed by Kenneth Marlatt, on "Tanning and the Leather Industry." Mr. Marlatt, who is superintendent of the tannery at Oakville, Ont., has made the industry a study in England for the last two years.

* * *

Bell & McCubbin, consulting engineers, St. Thomas, Ont., have opened an office at Chatham, Ont., with Geo. A. McCubbin in charge.

* * *

The Quebec Branch of the Canadian Society of Civil Engineers' annual meeting was held recently when the officers for 1911 were elected as follows: Chairman, P. E. Parent; secretary-treasurer, S. S. Oliver; executive committee, A. E. Doucet, E. A. Hoare, L. A. Vallee, A. R. Decary, W. R. Russell, R. O. Sweezy. The branch holds its meetings on the first and third Fridays of each month, Room 40, City Hall.

* * *

W. C. McGhie addressed a gathering of Engineers in Windsor on Jan. 26. Factory Inspector H. Clark also gave an address.

* * *

W. R. Stavert, chief of the sales dept. of Jenkins Bros., Montreal, manufacturers of valves has been touring the Canadian West in the interests of his company. The "crop" of orders is reported satisfactory. He found Western Engineers "Jolly Good Fellows."

* * *

Paul J. Myler, vice-president Canadian Westinghouse Co., Hamilton, has been elected president of the Ontario Motor League.

* * *

C. B. Hunt, who is retiring from the management of the London Electric Co., was presented with a traveling bag and an address, on Jan. 31.

The Engineers' Club, Toronto, have elected the following officers for the ensuing year: President, Capt. Killaly Gamble; 1st vice-president, Willis Chipman; 2nd vice-president, W. H. T. Hamilton; 3rd vice-president, Chas. H. Heys; directors, J. J. Ashworth, R. A. Baldwin, C. H. Acton Bond, W. A. Bucke, Edmund Burke, C. M. Canniff, W. E. Douglas, E. A. James, L. J. Street, Jos. B. Tyrrell, T. S. Young, and R. B. Wolsey, secretary-treasurer.

* * *

International Union Steam Engineers.

The monthly meeting of the Toronto branch of the International Union of Steam Engineers was held in the Labor Temple, Church Street, on the evening of Wednesday, 25th. January.

The transaction of the usual society business being over by nine o'clock, the meeting was thrown open to members and their friends, and developed into a most enjoyable smoking concert.

Local president Jones, was in the chair, and lost no time in calling on Bro. Wilson for a song, the acceptable rendering of which was followed by a paper, entitled "Directions to Follow in Case of Accidents," by Gordon C. Keith, managing editor The Power House. In Mr. Keith's absence, the reading of the paper was entrusted to Bro. G. D. Bly.

A general and interesting discussion followed, the members showing an appreciation of the necessity of their being prepared for the many emergencies arising out of their calling.

A lavish supply of good cigars handed round, a whole gallery of humorous and character songs by Bros. Wilson and Charlebois, a violin solo with pianoforte accompaniment by Bro. Omerod, a bones and pianoforte accompaniment by Bro. Smith, addresses on the license law, wage question and organization by Bros. Bly, Parkes and Scott respectively further songs, duets and trios by various members, brought together with the usual votes of thanks a very pleasant and profitable meeting to a close.

The attendance was in the vicinity of 130 and the enthusiasm displayed, not to speak of the musical talent it boasts, shows this local organization to be in a healthy and progressive state.

The next open meeting will be held on Wednesday evening 22nd February, the author of the paper on that occasion being Bro. Shipley, and his subject—"Refrigeration."

* * *

Pow Wow at Chatham.

An open meeting of the Chatham Lodge No. 21 C.A.S.E. was held on Jan. 26. Addresses were delivered by H. Clark, London, government factory inspector for the district west of London; E. A. Wilkinson, Canadian agent for the Lunkenheimer Co., Cincinnati; J. Billinger, Owen Sound; Alderman James Prichard, Chatham; and W. C. McGhie, Chairman Ontario Stationary Engineers' Board, Toronto.

The addresses were all instructive, each giving the engineer ideas for securing greater economy in his plant. Mr. McGhie spoke of the plans followed for the enforcement of the Engineers' Act in Ontario.

* * *

Canadian Society of Civil Engineers.

The twenty-fifth annual convention of Civil Engineers, was held in Winnipeg Jan. 24-27. The following officers were elected for 1911:

Past president, H. N. Ruttan.

President, C. H. Rust, city engineer, Toronto.

Vice-presidents, Holgate and Dodwell.

Councillors, representing District No. 1—Herdt, Johnson, Kelly, Shanly, Sullivan and Vaughn.

District No. 2—Archibald, Doane and McColl.

District No. 3—Doucet, Morkill and Parent.

District No. 4—Coutlee, MacPherson and Stewart.

District No. 5—Haultain, Stewart and Fellows.

District No. 6—Brydone-Jack, Heskett and Legrand.

District No. 7—Busteed, Dennis and Kennedy.

* * *

Montreal Notes.

The "Montreal Notes" feature is welcomed by engineers in this city, say our correspondents.

Signs are not wanting of a rejuvenation of what were considered hopeless yet pressing reforms. Thanks to "The Power House," and more "power" to it.

* * *

The explanations of and methods required in answering the various license examination questions is being anxiously looked forward to in your valuable journal.

* * *

There is still the usual crowd and demand for all grade of license on the first Wednesday of each month. It is boiler inspector Champagne's busy day, and an anxious day for candidates.

* * *

R. W. Findlay, 156 Dufferin Ave., Cote St. Paul, Montreal, is prepared to instruct candidates for the various licenses, and to put them through the ordeal successfully (Champagne willing.)

* * *

A real grievance we have is that to be on hand for the license examination means a loss of the whole day. Some system could surely be devised whereby men could make appointment at stated times of the day without sacrificing the whole of it.

* * *

The engineers of Manitoba, Ontario and other provinces of Canada, except Quebec, seem well organized, and imbued with a more fraternal spirit than we are in Montreal. The reports of their doings, social and otherwise, make us envy them somewhat, although "Jim Scotch" complains they are poorly paid. They can't have everything.

* * *

If "The Power House" keeps up the interest begun in us, we will make all of them stretch out a bit when we begin to move.

* * *

The publication of the Montreal City Boiler By-Laws in your paper would be favorably received, with a view to evoking criticism and opinion as to whether they are up-to-date and modern.

* * *

Sparks From London.

A special meeting of the Canadian Association of Stationary Engineers, London, No. 30, was held in their hall, 211 Dundas St., on Jan. 31. W. C. McGhie, chairman of the stationary engineers' board, Toronto, and Harry Clarke, factory inspector, gave two interesting addresses on the "Engineers' License Law," which was fully explained. A light lunch was then served and a very sociable evening was spent. There was a large turnout of engineers and their friends. President Geo. D. Fowler occupied the chair.

REFRIGERATION ISSUE.

The Refrigeration Issue of The Power House last year met with such success that we have decided to devote the March issue almost wholly to articles on Refrigeration. A number of excellent articles have been arranged for, including one by E. J. Greenstreet, F.R.A., I.C., cold storage architect, Toronto.

For the March issue we will welcome short, practical articles for our practical letter department. All accepted material will be paid for. Write us of your experiences and methods followed in the Refrigerating Plant.

THE EDITORS.

London No. 30, is in a very prosperous condition. Five new members will be initiated at the next regular meeting.

* * *

The fifth annual banquet will be held at the Masonic Hall, on Feb. 15. Bro. Sam. Cosford is chairman of the banquet committee.

* * *

Toronto No. 1, C.A.S.E.

R. G. B lack, of The Toronto before the C. A. S. E. Lodge No. 1. The meeting will be held in the association's rooms, Forum Building. It will be an open meeting and all engineers are invited.

* * *

Each year the Toronto C.A.S.E. No. 1 have been favored with an address by Prof. Bain of the University of Toronto These were of a most practical nature taking up such subjects that were of special interest to engineers. Those, therefore, who were present at the open meeting on Jan. 25 received a great treat in his lecture on "The Chemistry of Coal."

Mr. Bain took up the subject from the geologist's standpoint, the varieties, ash tests, heating value with calorific tests, test for volatile matter, and moisture, combustion of coal and the application of tests. He recommended that where possible, coal should be bought by specifications.

He referred also to the value of testing the stock gases for CO_2. In ideal practice the flue gas would contain 17 per cent. CO_2 but from 12 to 15 is considered good.

A hearty vote of thanks was tendered Prof. Bain, it being moved by Herb Terry and seconded by Charles Mosely The president W. E. Archer occupied the chair. At the close of the lecture refreshments were served.

* * *

The educational committee consists of A. H. Kirby, chairman; J. C. Tweedale, secy.; A. M. Wickens, J. W. Marr, J. W. Biggar, M. H. Kerr and T. D. McGhie.

* * *

U. of T. Engineering Society Banquet.

The twenty-second annual banquet of the University of Toronto Engineering Society was held on Jan. 19. The president, A. D. Campbell, was toast-master. The toast to Canada was proposed by L. R. Jones and responded to by Dr Robertson, chairman of the technical education commission and R. W Leonard, St. Catharines.

Dr. Robertson said Canada required to a remarkable extent the service of trained engineers. The commission on conservation had a vast task. Conservation was making "the' wisest use for the now," not keeping undeveloped, but properly developed. This must be by the application of intelligent labor, that was why the commission on technical education was appointed. The two great commissions—on conservation and technical education—were working together for the future greatness of Canada.

R. A. Sara proposed the toast to "Canadian Industries," and R. S. Gourlay, president of the Toronto Board of Trade, responded.

L. R. Wilson proposed "The Legislature," which was responded to by Hon. J. S. Duff.

President Falconer replied to the toast of "The University," proposed by J. S. Galbraith.

"Applied Science" was aptly proposed by Charles Webster and appropriately responded to by Dean Galbraith.

"The Engineering Profession" was proposed by W. O. Flynn, and acknowledged by W. Francis, Montreal.

The songs of the Science Octette, were features of the evening. The octette was composed as follows: Tenors, W. A. O'Flynn, W. A. Costain, P. S. McLean, G. B. McCauley; basses, J. H. Craig, W. C. Blackwood, R. B. Chandler, G. J. Mickle; conductor, Clayton S. Bush; pianist, H. Harris

* * *

Stratford "Specials."

At a recent meeting of the Stratford Lodge No. 31, C.A.S.E., W. G. Walters, the secretary, read an interesting paper on "Waste Gases in the Chimney." A discussion followed in which all the members present took part.

* * *

Plan to visit Stratford July 25, 26 and 27. It will be worth while.

* * *

A. R. Benson will be on the program for the Convention Banquet and there will be barrels of fun.

* * *

The committees are now busily at work on the Convention to be held in Stratford on July 25, 26 and 27. Letters regarding the Souvenir will be mailed at an early date and it is expected that the 1911 Souvenir will far surpass those previously published.

* * *

The city hall will be secured for the Convention meetings and the exhibit of power specialties. The floor space is sufficient to accommodate fifty or more exhibits. All engineers and owners of power plants should make a point to visit and examine the various exhibits.

One of the centres of interest in Stratford is the Grand Trunk Railway with its up-to-date shops. A. Kastalla is the chief engineer of the power plant and will welcome all visitors who wish to see an economically operated steam plant.

* * *

W. G. Walters, the C.A.S.E. secretary and honorary president of the Exhibitors' Association is beginning to look busy. His address is 590 Erie St.

Bro. Geo. D. Fowler, president of the London Lodge, C.A.S.E. No. 30, paid a friendly visit to Stratford, No. 31. on January 25.

* * *

A pleasant time was spent on January 18, at an At-Home given by the Stratford Lodge in their rooms, 74 Ontario St. There was a large attendance and all enjoyed themselves to the utmost. The president, Alex. Scrimgeour, acted as chairman and introduced the following excellent program:

Instrumental, Mrs. J. A. Robertson; chairman's address, A. J. Scrimgeour; comic song, A. R. Benson; address, W. G. Walters; solo, Mrs. Geo. Hird; instrumental, Master Hal. Walters; speech, J. A. Robertson; instrumental, Miss Bonnie Benson; speech, Geo. Hird; speech, Jake Shaefer; instrumental, Mr. and Mrs. J. A. Robertson; speeches, Mr. Edwards and Mr. Drewry, St. Mary's; song, Master Vernie Walters; comic speech and song, A. R. Benson; instrumental, Mrs. Robertson; address, August Kastella. After the program, the ladies served a luncheon which was followed by games, gramaphone selections and other amusements until a late hour. "God Save the King" terminated one of the most enjoyable evenings in the history of No. 31.

* * *

On January 19, W. C. McGhie visited Stratford, a day late for the banquet. A special meeting was arranged, however, and a large gathering of engineers greeted the chairman of the Ontario Stationary Engineers' Board, in the evening. Mr. McGhie addressed them on the Ontario Engineers' Law.

ALBERTA LICENSE LAW.

The Department of Public Works, steam boiler branch, has issued in booklet form a Memorandum of Information for the guidance of persons desiring to qualify as engineers under the provisions of the Steam Boilers Act of Alberta. This has recently been revised, and may be obtained by writing John Stocks, deputy minister of public works, Edmonton, Alberta.

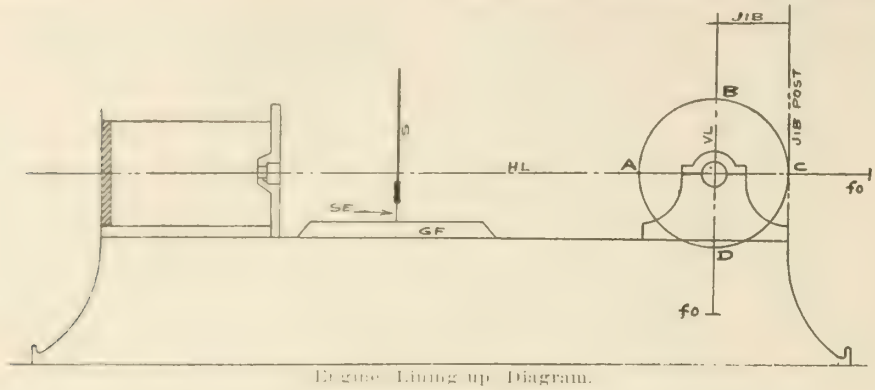
PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

TO LINE-UP AN ENGINE.

By Rodger Phillip Scott.

The question as given in the Montreal stationary engineers' examination assumes that the engine has been running for some considerable time and wants lining-up.



Engine Lining up Diagram.

Strip engine of cylinder cover, piston, connecting rod, piston rod and gland. Place a wood centre at outer end of cylinder bore, and through its centre, found by measurement from the cylinder bore, run a line through and fasten at f.o. behind the crank shaft, making sure that the line is central with the piston rod stuffing box.

Find next the centre of your crank pin between the crank necks at 4 given points; bring one centre to bear on the line at A and the other centre to bear on the line at C. If both centres touch the line the shaft is at right angles to the cylinder in that direction.

Your guide bars being away, place a straight edge across the guide face, and on top of it place a stock square.

The next procedure is to put up a jib post, and from the jib drop the line VL. Now stand right behind the shaft, and having made sure that your square is lightly touching HL, sight VL to the edge of the square. Having the other centres on the crank pin, bring one centre to bear at VL on B, and the other centres at D. If the centre meets the line at both points, the crank shaft is in line with the cylinder and guide face horizontally.

It is to be noted that plumb lines or bobs are prohibited, as are also lines from the ceiling on account of electric wires. The latter in any case does not permit of lining up the engine to itself. Memo of notation used: HL=horizontal line, VL=vertical line, S=stock square, SE. straight edge, GF=guide face, fo=fixed objects.

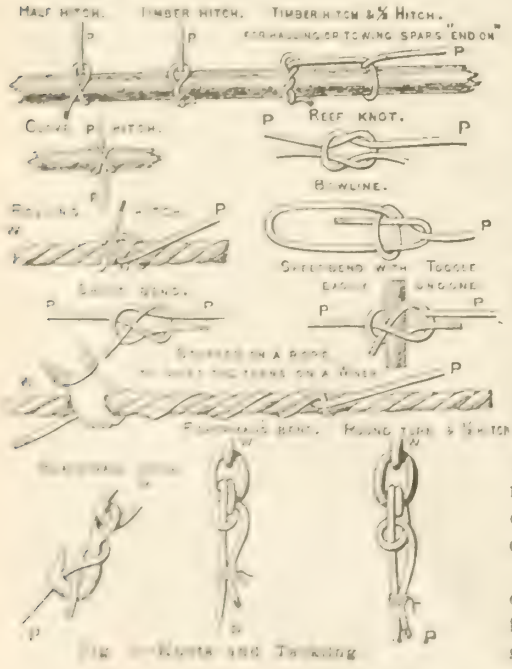


Fig. —Knots and Tackling

KNOTS AND TACKLING.

By Halyard.

To most men engaged in manufacturing, erecting and building, has come the necessity of making a knot which will hold permanently if need be, of making a reliable but easily applied temporary connection, or of having to sling some piece of machinery for lifting or lowering to some other level.

In the domestic sphere there is an oft repeated call for the exercise of "knotology," and who of us has not blundered through the work adding knot to knot, increasing as it were safety where it is impossible to do so, wasting rope as regards quantity used, and further by cutting asunder when the package or connection wants undoing.

Have you ever noticed the perspiration of excitement and exertion break on the face of a novice in knots, or have you seen the calm, easy and seemingly careless manner of an expert. The work of the latter takes seconds for the minutes of the former to accomplish.

The purpose of this brief article is to bring before our readers the opportunity of becoming intimate with the methods adopted in making knots.

The sketches Fig. 1 show those commonly used, each of which is simplicity in itself, is easy of application and reliable in effect.

They are shown open, in other words are not drawn taut, the idea being to convey the method of their formation better.

As an aid to those who wish to master the intricacies of knot making, it should be a basic principle that no two parts which would move in the same direction if the rope were to slip, should lay alongside of and touching each other.

The sketches Fig. 2 show the commonly used forms of tackling, and to those having erection work to do, the various items shown and self-explanatory, will be found serviceable and safe.

It is a matter of common knowledge that probably not one man in twenty employed in the mechanical and manufacturing trades can make reliable knots or rig up satisfactory tackling if called upon. The art, for such it is, does not somehow appeal to them as a valuable asset, but is looked upon rather as outside their particular field, and a purely nautical necessity.

A practice in many shops is the employment of a ship rigger or sailor to

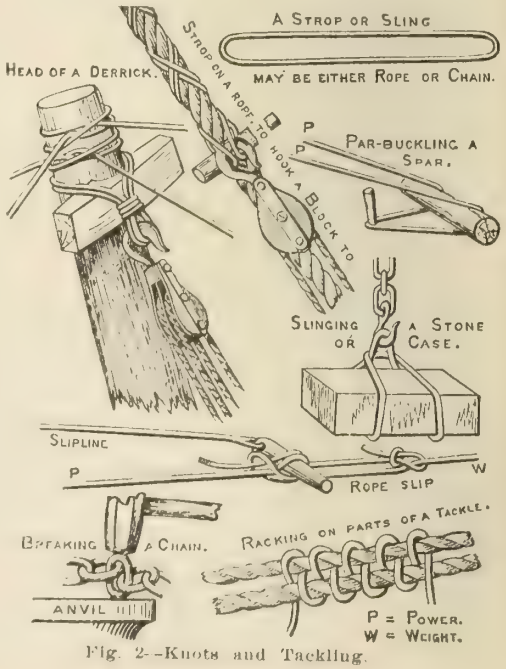


Fig. 2.—Knots and Tackling.

care for lifting, knotting, tackling and slinging required. The opportunity which this affords is well worth taking advantage of by the employes, particularly as the means of experimenting, a few feet of cord, and the leisure to do it, are within the reach of all.

To the onlooker the artful manner in which an expert does his work, gives rise to the impression that the operation is too simple to be effective, and fills them with fear as they anticipate the dire results they believe are sure to follow the particular effort he has designed to carry out. The idea that knot upon knot, twist, half hitch and loop need be multiplied to give quantative appearance, dies hard.

Simplicity of design and manufacture in most cases commends itself, being more economical and surer in results. Knotting and tackling call for the utmost simplicity, just as much and possibly more so than most things, but to attain that desired end, a more general cultivation of familiarity with them should be considered an essential part of every engineer or mechanic's brain and hand equipment.

HOT DISCHARGE PIPE.

A few days ago upon entering the compressor room I detected the odor of burning oil and began to look around and to feel the bearings, but found them all cool. The discharge pipe from the air cylinder is in an obscure place but I finally discovered that this pipe was red hot for a distance of about 4 feet from the cylinder. My first thought was that the cooling water had been stopped in some way and I began to think of what would happen if it should suddenly start again. I closed the throttle, then shut the valves of the cooling-water line and began to carefully look things over. I was surprised to find the air cylinder cool, so lifted the relief valve on the receiver and started the engine, running it without any air pressure until everything was cool

I now closed the relief valve and ran the engine against 90 pounds pressure, and in about five minutes the pipe began to get hot again. I then shut down the engine and took off the cylinder head, and found the discharge side of the cylinder full of burned oil and ashes. Some dirt and rubbish must have gotten in regardless of the fact that there was a strainer in the intake

It is my opinion that the area was so small that the excessive friction heated the air hot enough to make the pipe red After removing two buckets of burned crust, I was bothered no more with the pipe heating.—M. G Lett in Power

Correspondence

HEATING BOILER FEED WATER.

I know a man who is using exhaust steam from his engine to heat his boiler feed water in an open heater without an oil separator. He uses a high-grade mineral oil and says it does not do his boiler any harm at all. He has been doing this for ten years. I would like to hear some of our readers' opinions on this.—"Bunkered."

* * *

The practice referred to is one which is not uncommon and the reason of its satisfactory performance is that a great deal of the condensed exhaust steam with the objectionable accompanying oil does not re-enter the boiler. In order to condense the exhaust steam by means of the method indicated, a large tank of water is necessary of which the steam used by the engine forms only a small part. Then, in what is used as boiler feed water there will be very little condensed exhaust steam and oil and by using some soda the effect of the oil on the boiler will be practically annulled.—C. L. Gulley.

LOSS OF PRESSURE

J. V. Adams, Campbellford, wants to know what loss of pressure may be expected in a 300 feet steam pipe line, carried underground, or in other words, what boiler pressure will be required to ensure 70 pounds at the engine when situated 300 feet from the boiler.

As the size of piping proposed is not stated, and as this enters largely into the question as does also the provision of a suitable non-conducting composition on the piping, it is not possible to make a reasonably accurate deduction. 100 pounds boiler pressure therefore should be provided, but if Mr. Adams will kindly supplement his question in the direction referred to, we shall be glad to give him more definite information. —Blackrock.

MISCELLANEOUS QUERIES.

January Issue. — A. F. Moray writes to say that his query 1 should have read "at what point in the stroke of an engine is the strain greatest on the cylinder head studs," and that the syphon sketch, query 14, was shown inverted. Will our readers please note and let us have their views on Mr. Moray's questions.—Editor.

BOILER DESIGN, CONSTRUCTION, ETC.

Your leading general article on boiler design, construction, operation, repairing and inspection by H. S. Jeffrey, in the January issue of "The Power House," has been indeed, a revelation to me of what I have been misinformed upon with regard to the return tubular boiler set in brickwork.

First of all and perhaps most important is the information that to this type of boiler there is design. These boilers I have always had the impression were made in standard sizes, varying slightly in length for given diameters, in thickness of shell plate, number of courses, diameter and number of tubes to suit the fancy of purchasers. The shell plates are made standard lengths and widths at the steel mills to suit the foregoing conditions, tubes. diagonal stays, heads likewise, now where does the design come in? It may be the riveted joint and means substitution of a high sounding word for that of "scheming" to make it as cheap as possible.

The dissertation on what operating engineers should know and be able to perform, leads me to wonder if "Jim Scotch" is not about right in his plea for higher wages.

The paragraph referring to boilermakers is certainly well woven. Nobody expects a boilermaker to be a boiler designer, his name implies his profession, and for the same reason a boiler designer need not be and seldom is a maker of boilers. It is somewhat late in the day to say that a riveter or flue man is not a boilermaker, and it is carefully omitted to say that a boilermaker in more than name should be both of them and an expert repairer to boot.

Much has been made of a very little in the article and much more criticism could be offered, but seeing that it is the first of a large series I will meantime, content myself, realizing that further opportunity will be afforded, if this introductory effusion is any criterion of what is to follow.—Laddie Cliffe.

LAP JOINT LONGITUDINAL SEAMS

A. F. Moray says he does not agree with A.E.B. (now Blackrock) that the lap joint longitudinal seams on the shell of a boiler are so black as painted, because they do not receive abuse when the boiler is in operation.

If Mr. Moray will read the article again carefully, he will find that nobody said so. Under the heading, "Cause of Ultimate Failure," he will find as follows: "The outstanding feature of weakness in the lap joint is the treatment that the steel receives in the offsetting process necessary to this construction. This initial punishment it undergoes lays the foundation for aggravation when the completed boiler in service carries with it the uncircular offset of its shell plate joint."—A.E.B.

ELECTRICITY FOR STATIONARY ENGINEERS

HOW TO TAKE CARE OF A DYNAMO.

By C. L. Gulley, B.A.Sc.

IN order to properly take care of any piece of electrical machinery one should be somewhat familiar with its performance and know what certain indications mean which are absent in the performance of a machine operating to its best advantage.

The following suggestions will give an idea where to look for trouble in a direct current machine which has been set up and left in good running order.

The parts giving most trouble are the brushes and commutator. Unless regular attention is given them, sparking is liable to occur which, if not remedied, will in all probability cause a shutdown. To secure best results the commutator should be cleaned every morning just after starting by applying a clean cloth to its surface to collect all dirt, etc. If sparking still continues, sand paper may be used to loosen the dirt, carbon, etc., and a cloth slightly dampened with gasoline may be used. In no case use emery cloth in place of sand paper. Brushes are often the cause of the sparking due to unequal wearing or faulty brush pressure. They should be filed or ground occasionally to fit the surface of the commutator. Vaseline is sometimes used on a sparking commutator, but in many cases too much is applied which is worse than not enough.

Sparking will often continue after the commutator and brushes are perfectly free from dirt. It may be due to any one or more of the following causes:—The commutator may be rough due to excessive sparking at some earlier date, or too high mica, of to a loose segment in the commutator, or to a segment being higher or lower than the rest, all these causing the brushes to leave the commutator for a short period of time thus drawing a spark, or to wrong electrical connections or to wrong position of the brushes. In all but the two last of these cases the sparking will be local and if the machine be run slowly the trouble can be located, whereas sparking will be general if due to a dirty commutator or to wrong setting of the brushes. If the brushes have been moved this can be corrected by moving them in either direction till the sparking ceases. If the commutator is not too rough this fault can be remedied in the shop by using sand paper, care being taken to brush off all copper dust before starting, otherwise it must be sent to an electrical repair shop where it can be turned down on a lathe or where the electrical connections can be corrected.

Chattering.

Another trouble that is liable to occur in high speed machinery is chattering of the brushes. This generally is found where the brush-holder is of the box guide type with a spring on the top of the brush to keep it in place. Lubrication will stop this only for a short time. The clamped type of holder is generally free from bad chattering but will rock on the commutator if the machine is running slightly out of true, causing poor contact and perhaps serious sparking.

The other parts that need constant attention are the bearings. These, of course, should be oiled daily at least or more frequently if necessary. Occasionally the oil wells should be cleaned out by running gasoline through them and refilling with fresh oil. Bearing trouble is usually preceded by excessive heating of the parts.

Troubles with alternating current machines, other than bearing trouble, generally require expert attention.

ELECTRICITY ON THE "OLYMPIC."

The electrical power plant of a modern transatlantic steamer is no small installation. The steamer "Olympic" is to be provided with four units generating 2,144 horse-power. This power will be employed in lighting the vessel and for radiators in the first-class quarters; for cooking purposes, for operating various machines, cranes, winches, etc., and for running two passenger elevators and eight freight elevators. The lighting system will total 100,000 candle power. At present, while being fitted up, the vessel is furnished with electric light and power from a 320-kilowatt plant on a tug moored alongside. The tug is also provided with a steam fire pump for use in case of emergency.

SEAL FOR QUARTZ LAMP TERMINALS.

Fortunately, the co-efficient of expansion of platinum is very close to that of glass. Consequently, electric lamps which employ a vacuum tube or globe of glass are fitted with platinum terminals fused in the glass. Recently, in mercury vapor lamps quartz has been substituted for glass, so as to permit of higher temperatures and a much higher light efficiency. The expansion of platinum is greater than that of quartz, and hence is unsuitable for such lamps, as the seal is sure to break in a very short time. Instead of platinum, an alloy of nickel and steel, called "invar," has been employed. Although the expansion of this alloy is greater than that ol quartz, a tight seal has been effected by giving the wire the form of a conical stopper, and then covering the seal with mercury to provide a hermetically closed joint. A filling of cement prevents the mercury from spilling out.

ELECTRICAL TRADE GOSSIP.

M. B. Logan has severed his connection with Siemens Bros. Dynamo Works, with whom he has been connected for several years and has joined in partnership with C. T. Bowring. They have opened up offices at 34 Victoria St., Toronto, as consulting engineers. Mr. Bowring, for many years, was with the Westinghouse Electric & Mfg. Co.

* * *

C. H. Rust, City Engineer, Kenneth Atkin, Electrical Engineer and J. W. Moyes, Consulting Engineer, Toronto, spent some time this month in New York investigating the Edison storage battery, particularly as a motive power applied to street cars.

* * *

Henry D. Bayne has been appointed special agent in Montreal, of the Canadian General Electric Company and the Canada Foundry Company.

* * *

The meeting of the Canadian Electrical Association held in Toronto on Jan. 20, decided in favor of affiliation with the National Electric Light Association. This means the adoption of the constitution of the N.E.L.A. in respect to fees, the basis of which is company membership according to the population of the town or city. The date suggested dor the 1911 convention in Winnipeg is July 12 to 22.

A. C. ENGINE TYPE GENERATORS.

A line of low speed, 60 cycle, engine type alternators embodying a number of new features of design has been recently placed on the market by the Westinghouse Electric & Mfg. Co. The line covers capacities from 50 to 1,100 k.v.a. 2-phase or 3-phase, and standard voltages of 240, 480, 600, 1,200 and 2,400 volts. A striking characteristic of the

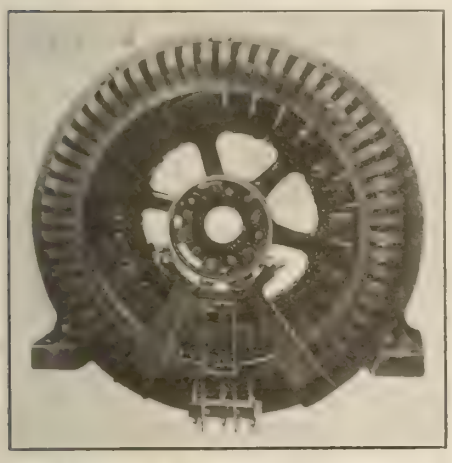


Fig. 1 Type E Generator, Collector End. 75 k.v.a., 200 r.p.m.

entire line, as shown by the machine already in operation, is the ability of the generators to successfully carry commercial loads of low power factor.

As the general construction and arrangement of parts of the revolving field generator is familiar, this description will be confined to the new features of this design, known as the type "E".

The stator frames are of such designs as to give great rigidity and plenty of freedom for the end connections of the armature winding. At the same time the construction is economical of material and affords excellent ventilation. The frame consists of a one-piece casting, except in sizes of such diameter that a split frame is a necessity for shipping reasons. In such cases the halves are bolted firmly together, making practically a solid frame. The frames of the smaller sizes are provided with slide rails on which the frame can be shifted to expose the rotor

The armature core is built up of laminations of japanned steel of good magnetic characteristics. The laminations are dove-tailed in recesses in the frame. They are assembled under pressure and securely held by finger plates and end plates. Generous ventilating ducts are provided in the core to maintain uniform low temperature. The teeth are firmly supported at each end of the core by finger plates

Repairs to the armature winding are very easily made because of the design of the winding. The armature slots are open and the coils are held in place by wedges. The coils are entirely interchangeable and are completely formed and insulated before assembling in the core.

The end bells provided for the protection of the armature winding and attached to the end of the frame are of segments built up into circular form and so bolted together that they are light and open, yet rigid and indestructible.

The brush holder brackets, except in the larger sizes, are bolted to the armature frame, which makes each generator complete in itself. On the larger sizes, however, the brush holders are mounted on a pedestal which is to be bolted to the engine bed plate. At least two brushes are provided for each collector ring, which makes it possible to adjust any brush without opening the field circuit.

The rotor consists of a casting with laminated pole-pieces bolted on. The proportions of the casting are worked out with special reference to cooling strains, and the material used provides a homogeneous magnetic circuit. Edgewise would strap is used for the field coils of all type "E" generators. This makes an ideal construction for field coils as every turn of winding is exposed to the air and heat is readily radiated and dissipated. The insulation between turns is of fire-proof quality.

The entire design of the type "E" generators is arranged for thorough circulation of the air.

The field poles of type "E" generators are so designed that a cage damper winding may be used when desired. Such a winding consists of a series of copper bars embedded in the pole faces, with the ends short-circuited like the squirrel cage winding of an induction motor. The winding serves as an effective damper to any fluctuation and thus tends to prevent "hunting." The cage damper winding is not essential to satisfactory operation, however, when modern steam engines are used as the prime movers. Where internal combustion engines are used the cage damper winding is advisable.

The collectors are of the spider type, consisting of two machined cast iron rings mounted on a cast iron bushing or hub, from which they are carefully insulated. The hub is bolted to the rotor spider casting, so that the alignment is entirely independent of shaft adjustments.

Ample factor of safety is allowed throughout the mechanical design and the electrical design is such that overloads and low power factors do not interfere with satisfactory service.

A visitor to Niagara Falls for the first time was heard to exclaim in tones expressive of deep-seated conviction, "that it was a fearful waste of water." A gentleman standing by, and thoughtfully impressed with the scene, ventured to ask the visitor a most natural question under the circumstances, "are you an engineer?" Judge of his surprise when "no, I am a milkman," was hurled back.

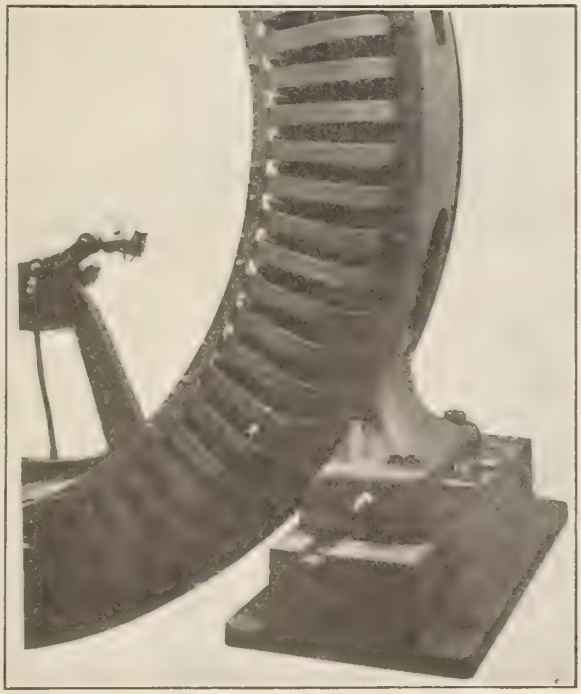


Fig. 2. Adjustable Shoe and Slide Rail, Type E Generator.

Fig. 3—Brush Holder Bracket Stand, Large Type E. Gen-

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

GIFFORD STEAM TRAP.

One of the most important appliances [illegible] in steam plants is the steam trap. There are many differing opinions on the relative merits of the various traps now in use, and the engineer sometimes [illegible] a steam trap should

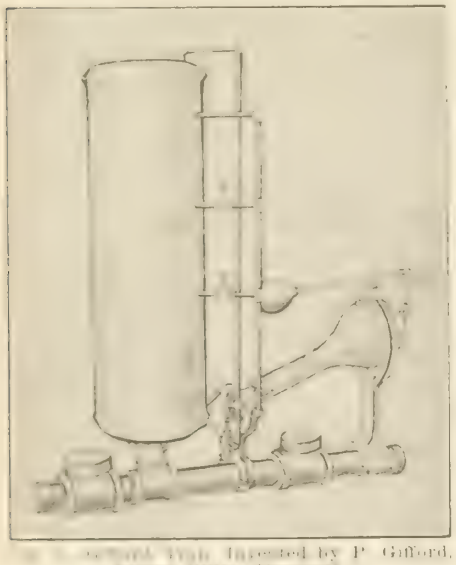


Fig. 1.—Gifford Trap, invented by P. Gifford, Power Bldg., Montreal.

consider the question carefully, especially the conditions existing in the boiler room and the point where the trap is to be located. There are several types in general use, the principal ones being the expansion trap, the float operated trap, and the tilting traps. The tilting traps can be used as separating, return, lifting or vacuum traps.

A steam trap discharging once a minute working for 24 hours would discharge 129,600 times in 3 months. This gives an idea of the wear and tear on the steam trap. A wise engineer will watch his steam traps for they require his care and attention, especially when they are used under high pressure conditions. In well regulated plants, those that are run economically, every trap is examined at intervals of one or two months, depending on the pressure conditions. To make this regular inspection and the replacing of worn parts as simple as possible, the trap should be of the simplest construction. The engineer should know all the details of the trap he buys in order to have a trap to meet the actual conditions of his equipment, and particular attention should be paid to the size of the trap ordered, it being of great importance that the trap should be large enough to relieve the [illegible] of absolutely all condensation as it forms. More steam traps give dissatisfaction from this lack of capacity than from any other cause and the engineer should remember that the efficiency of much good machinery is reduced through defective and improper trapping.

A new idea in return, lifting pump, and vacuum traps, and a new application of these traps in the form of a complete Duplex System has been invented, patented and successfully operated by Percival F. Gifford, of Montreal. This new trap will be known as the Gifford Trap. It makes use of the tilting principle in the handling of condensation, effecting a complete saving of the heat units.

Single traps of this design may be used as return traps when they are placed above the boiler and fed by separating traps through a receiver, discharging the water into the boiler against any pressure. As lifting traps the water may be fed to them at low, even atmospheric pressure, and when full they will lift the water two feet for every pound of boiler pressure, discharging the water to a return trap or a receiver. As vacuum traps they will operate, relieving the vacuum line of condensation without interfering with the vacuum in any way.

As will be seen by the design, the traps are unlimited in size and capacity as the capacity of the traps is all in the upright tanks, the tilting bowl only being employed to operate the steam valve.

There are a number of overflows from the tank of the bowl, thus giving the trap as many different capacities as there are overflows. This point in the trap is well worth noting, for when a return trap is bought for a plant it should be large enough for the heaviest day's work possible. With the Gifford Trap, by opening one of the lower overflows, the trap is made to operate so as to save any delay and subsequent loss of heat. When all overflow valves are closed the trap has again its maximum capacity.

This trap may be insulated with asbestos which saves considerable loss of heat through radiation. This is probably the only return trap that can be insulated practically. Should dirt or scale collect there are no internal pipes. The cleaning will be a comparatively simple operation as every part is accessible.

The new Duplex System, also invented and patened by Percival F. Gifford, consists of one of the above described traps used as a lifting pump, but instead of placing an ordinary return trap on the boiler as is usually done in other trap systems the inventor has made use of the pressure that enters the lifting trap when it is dumping, to close a diaphragm valve. This valve on the tank above the boiler is also vented and the pressure in the tank escapes

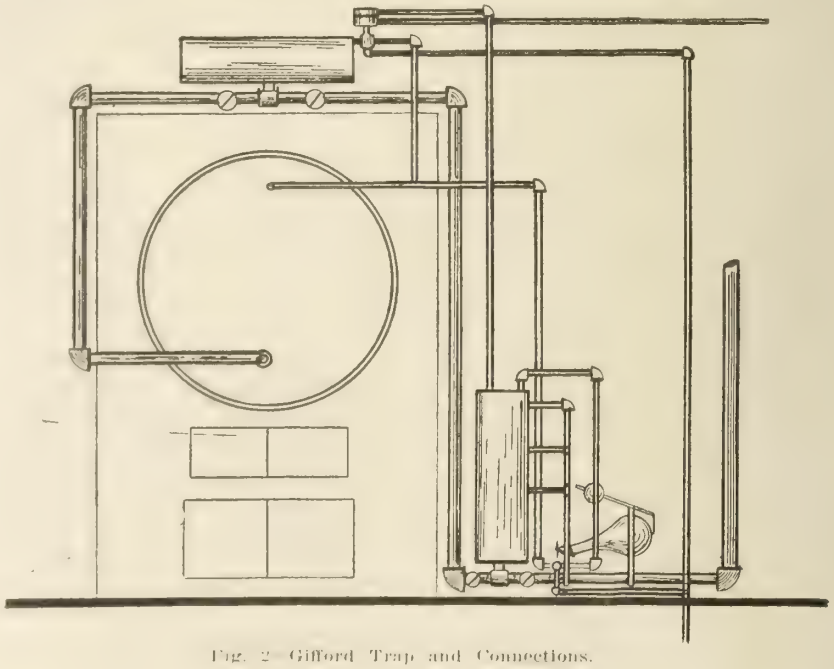


Fig. 2.—Gifford Trap and Connections.

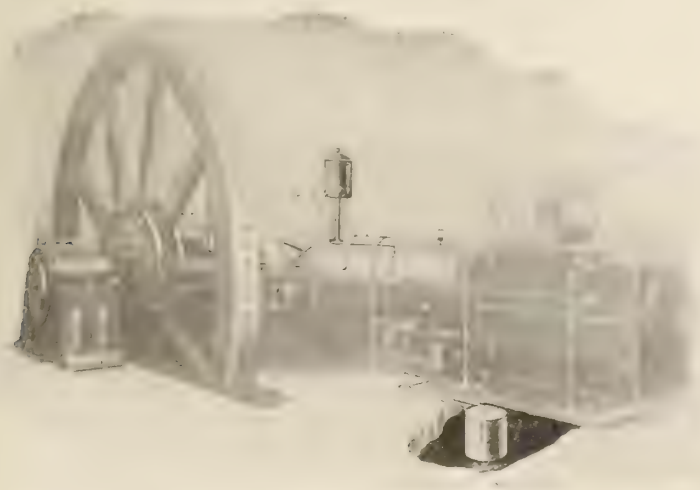
through the vent, allowing the water which is rising from the lifting trap to enter unhindered. When the lifting trap is vented, the operation in the diaphragm valve is reversed, or in other words the vent is closed and the boiler pressure allowed to enter the tank, equalizing the pressure in the tank with that in the boiler, thereby allowing the water to enter the boiler by gravity. The point in this system is the fact that although the tank above the boiler is really a return trap, yet there are no moving parts outside of the valve discs, the employing of the water to operate the trap having been done away with entirely.

What will appeal to all users is the simplicity of the single traps and particularly of the Duplex System, and as a result of this simplicity comes a very natural result viz., a price which is very attractive and should make this new Canadian invention popular on the United States as well as the Canadian market.

The Gifford trap has been placed on the market by Percival Gifford, Power Bldg., Montreal.

CONTINUOUS LUBRICATION FOR SMALL ENGINES.

The economies obtained from the continuous systems of lubrication for large engines, has led to their adoption on small engines, compressors, pumps, etc. A system for small plants has been designed by the Pittsburg Gauge & Supply Co., 30th St. and Liberty Ave., Pittsburg, Pa. This system known as the "White Star," is applicable to steam and gas engines, ice machines, turbines, pumps, compressors, etc., of 500 h.p. and smaller. It consists of White Star (engine type) filter with pedestal for attachment to engine frame, automatic



Continuous Lubrication, Pittsburg Gauge & Supply Co., Pittsburg.

drain tank, pump, necessary sight feeds, compression fittings and steel tubing The same oil is used over and over without re-handling.

The Pittsburg Gauge & Supply Co. have prepared several bulletins, No. 01, 02 and 03 treating of lubrication. These are supplied free to engineers on application.

NEW FURNACE GRATE.

A new grate has been invented which comprises a series of parallel longitudinal bars provided with vertical hollow bushes or sleeves. In each bush is a grate tooth comprising a broad toothed head and a long projecting shank. The shank when in normal position projects below the supporting bar and its lower end is rounded. At a proper distance below the grate the furnace is provided with beams or ways on which is mounted a roller. By rolling this roller it engages with the lower rounded end of the shanks and thereby pushes them up,

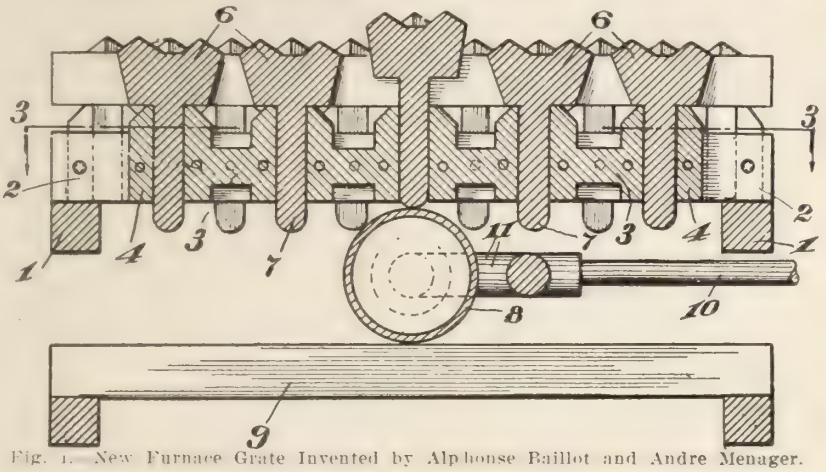


Fig. 1.—New Furnace Grate Invented by Alphonse Baillot and Andre Menager.

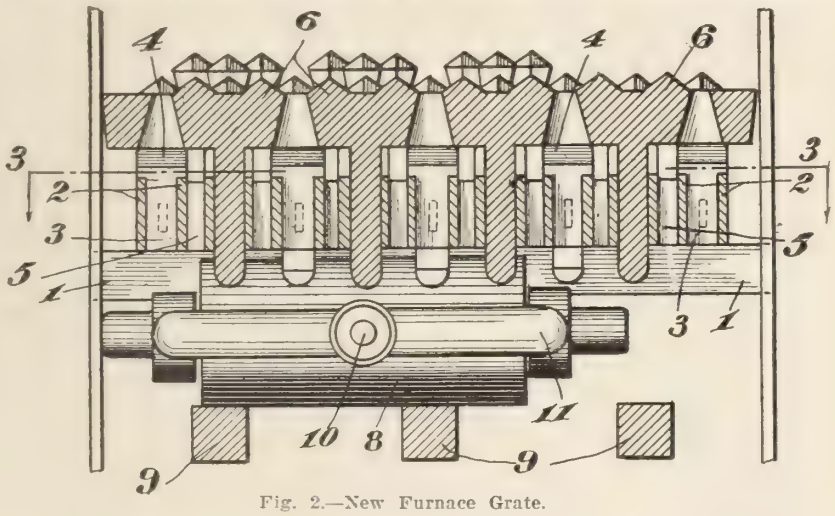


Fig. 2.—New Furnace Grate.

thus giving a vertical movement to the teeth and permits the ashes to fall into the ash pit. The teeth are arranged in rows diagonaly to the supporting bars. The roller is operated through the ash door by means of a handle and yoke.

This device permits the cleaning of the ashes without opening the furnace door and the consequent cooling of the furnace. It also affords a large air space. The top of the toothed heads is the only part which comes in contact with the fire, therefore the wear on the other parts is very small. Each tooth can be replaced individually when a new one is necessary. As it is held in its sleeve by its weight only, it is a very simple matter to pull out the old one and insert a new one in the sleeve. The replacing of one or more teeth would even be possible with the furnace in operation. It would be necessary to open the fire door to remove the coal from over the bad tooth or teeth and pull these out and replace them with new ones.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

NELSON—The International Electrical Co., [illegible] Nelson and Portland, Ore., has [illegible] for the development of a large electric power plant from the falls on the Pend d'Oreille river. The river runs from [illegible] the United States, some 50 miles [illegible] at Creston, B.C., and for nine miles before reaching the boundary it is a series of rapids. At a point some six miles above, on the Canadian side, a site admirably [illegible] for the necessary development works [illegible] exist, and it is expected that a [illegible] will be erected by the vicinity, to be [illegible] by W. J. Moore, hydraulic [illegible] of Spokane, has made an investigation and report on the power sites of the river, in which it is stated that the upper site [illegible] total development of 65,000 horsepower and that the cost will be about $80 per horsepower. The Sheep creek and Ymir mining districts are only fifteen miles away, and the power sites are within 100 [illegible].

VANCOUVER—Additions are planned by P. Burns & Co. About $200,000 will be spent on the abattoir and packing plant.

PRINCE RUPERT—The Atlin Construction Co., who are building the new plant for the Canadian Fisheries & Cold Storage Co., announce that they are receiving bids on refrigerating machinery for the plant, which includes three 75-ton machines and a 50-ton [illegible].

VANCOUVER—The City Dairy & Produce Co. is installing a 10-ton ice making plant, [illegible] by the Triumph Ice Machine Co., [illegible]nati, O.

VANCOUVER—A 3-ton refrigerating plant has been installed in the Granville Public Market, machinery furnished by the Armstrong Machinery Co., Spokane, Wash.

VANCOUVER—The Richmond Dairy & [illegible] Co. is preparing to install a 75-ton refrigerating plant, contract for which was let to the York Mfg. Co., York, Pa.

VANCOUVER—The Vancouver Ice & Cold [illegible] Co. are enlarging their plant and installing a 130-ton refrigerating machine, [illegible] by the F. W. Niebling Co., Norwood, O.

VANCOUVER—The Canadian Fishing Co., who are building a large fish freezing plant, [illegible] refrigerating plant of approximately 150 tons daily capacity. Contracts have been let to the Triumph Ice Machine Co., Cincinnati, O., for four 42-ton refrigerating machines and a complete freezing and ice making system. The machines will be [illegible] When completed the plant will be, it is stated the largest halibut freezing plant in existence.

Alberta.

ALBERT—The [illegible] is to have its new power plant in Victoria Park in operation this month. The apparatus already installed consists of 1,500 h.p. Babcock and Wilcox [illegible] equipped with chain-grate stokers, 660 h.p. 200 r.p.m. 3 cylinder compound Robb engine, direct connected to a [illegible] 600 k.w. generator. [illegible] is chief engineer of the [illegible].

CALGARY—[illegible]well & Hamilton are [illegible] a refrigerating plant, [illegible] ammonia side and direct expansion piping, was let to the York Mfg. Co., [illegible].

[illegible] at a meeting of the [illegible] on the Ineffectiveness of the present [illegible] to be made later for the installation of an extra [illegible] would involve an expenditure of $40,000. [illegible] Thomas Duncan is in favor of [illegible] Water Power Co. [illegible] upon application to A. J. McAllister, [illegible] Alta.

EDMONTON—Application has been made to the Dominion Government by this city for power rights on the Grand Rapids on the Athabasca River. Plans filed with the application show a maximum power, if all the dams are built, of 60,000 horsepower.

CALGARY—A third incinerator will be built by the city this summer at a cost of $70,000.

STRATHCONA—P. Burns & Co. have an option on 27 acres here and will probably erect packing and cold storage plant.

Saskatchewan.

SASKATOON—An expenditure of $140,656 is recommended by the city electrician, E. L. White, in order to double the capacity of the city light and power plant.

Manitoba.

WINNIPEG—Plans have been completed and contracts are being let for the new cold storage warehouse of the Manitoba Cold Storage Co., which is to be a 10-storey building, 100 by 110 feet in area.

WINNIPEG—The Winnipeg Electric Ry. Co. have awarded the C.G.E. contract for four units of 3,000 k.w. each for new power plant to be erected this summer.

Ontario.

WESTON—The Advance Machine Works, Walkerville, furnished an alternating current three-motor electric crane for the plant of the Roman Stone Co., here.

TORONTO—J. Eaton will have his residence equipped with a 6-ton refrigerating plant by the York Mfg. Co., York, Pa.

HAMILTON—The Kuntz Park Brewing Co. has ordered a 4-ton refrigerating plant from the York Mfg. Co., York, Pa. for cooling storage room, etc.

BELLEVILLE—Fire caused about $5,000 damage to R. J. Graham's cold storage building, recently.

BRANTFORD—The Waterous Engine Works are enlarging their plant. The additions will cost $45,000.

BARRIE—The Canada Producer & Gas Engine Co. are sending a carload of engines to St. John, N.B. These vary in size from 3 to 20 h.p. A carload will be shipped to the west in about a week. They are installing Weber gas engines in a power plant at Plessesville, P.Q. for the Savire Guay Co.

LONDON—At the annual meeting of the London Street Railway directors it was decided to build an up-to-date steam power plant.

FORT WILLIAM—The Canadian Iron Corporation were awarded the contract for the supply of pipe for the summer; prices: $37.50 a ton for ordinary pipe and $60 a ton for special pipe. The Kerr Engine Co. and the Canadian Fairbanks Co. were awarded the contracts for the valves.

ST. CATHARINES—Sealed tenders addressed to "The Chairman, Water Works Commission," endorsed "Tenders for Pipe and Specials"—Gate Valves—Pig Lead, will be received up to noon on Tuesday, February 28th 1911, for the cast iron pipe and special castings 12-in. to 36-in., Gate Valves 4-in. to 36-in., and pig lead required. Alex. Milne, Superintendent.

GUELPH—Charles W. Barber will erect a [illegible] cold storage plant, size 28 x 98.

FORT WILLIAM—The Kaministiqua Power Co. have decided to increase their plant at Kakabeka Falls.

Quebec.

MONTREAL—Joseph Girouard, bottler aerated waters has installed a 5-ton refrigerating plant furnished by Fred W. Wolf, Jr., Chicago.

MONTREAL—The Royal Victoria Hospital [illegible]ated waters, has installed a 5-ton refrigerat[illegible] plant, furnished by the York Mfg. Co., York, Pa.

MONTREAL—$1,257,000 will be spent by the city on a filtration plant.

MONTREAL—Eadie Douglas & Co., Montreal, who a few years ago opened a mechanical department, have so increased this branch of their business that they now have their [illegible] engineering department in charge of [illegible] engineers who are able to quote [illegible] Canada on any of the lines represented by their principals. They represent some very important firms, amongst others, B. F. Sturtevant Co. (eastern Canada) fans, blowers, heating and ventilating sets, vacuum cleaners, generating sets, motors, steam turbines, engines, etc.; Joseph F. Ryerson & Son, iron, steel, machinery; Shaw Electric Crane Co., electric traveling cranes and controllers; Lenher Engineering Co., Taylor Gravity Underfeed Stokers; Direct Separator Co., Sweet's Steam and Oil Separators, exhaust heads, etc.; James Beggs & Co., Blackburn-Smith Oil Filter and Grease Extractor; Nelson Valve Co., bronze valves, iron body and steel valves, accessories and fittings; U. S. Gauge Co., steam, pressure, vacuum and recording gauges; Hayden & Derby Mfg. Co., Metropolitan injectors, H. D. ejectors; Alphons Custodis Chimney Construction Co., radial brick and concrete chimneys.

MONTREAL—The D. K. McLaren Belting Co., Montreal, move on May 1, to new premises which they have purchased on St. James Street, formerly the property of the Kellert & Co. Their new premises will provide nearly double their present capacity necessitated by their increasing business.

MONTREAL—C. K. Crane, of the Crane Co., manufacturers of valves, Chicago, paid a visit to their Eastern Canada representative, W. J. Wall, recently.

MONTREAL—The Directors of the Saraguay Electric & Water Co. have authorized Charles Brandeis, civil and electrical engineer, 4 Phillips place, Montreal, to proceed with the plans for their new power house, machinery, etc., at an estimated cost of $225,000. Steam turbines will be installed in units of 3,000 h.p. each.

New Brunswick.

SHEDIAC—The Shediac Electric Light Co. have started up their new plant. The equipment consists of two 18-inch Kennedy water wheels and a C.G.E. 75 k.w. 2,300 volt, 60 cycle generator.

ST. JOHN—It is said the Grand Falls Power Company are already preparing to begin active development operations.

GRAND FALLS—The Maine & New Brunswick Electrical Power Co. is making arrangements to build a power line from its plant at Aroostook Falls to Limestone, Van Buren and St. Leonards running near Grand Falls. The object is to sell electrical power for lights and motors in the towns reached, also to furnish electrical power for the construction work during the establishment of a power plant on the St. John river at Grand Falls, which, it is understood, will soon be built by a company which has recently gained control if it.

Nova Scotia.

LIVERPOOL—A scheme is on foot to harness the extensive water powers in this vicinity for the purpose of supplying electricity. Surveying operations under the supervision of Mr. Holgate, Montreal, are being carried on. J. L. McLeod and Geo. S. McLaren, pulp mill owners, Liverpool, are interested.

Tungsten Lamp Calendars.

The Canadian Tungsten Lamp Co., Hamilton, have issued an attractive and very striking wall calendar for 1911, about 14 x 28 inches in size. The illustration shows a hall and staircase lighted by a tungsten lamp held in the hand of a Salome dancer. On the floor is a "Kolloid-Wolfram" tungsten lamp package, the whole design being specially prepared to draw attention to these lights.

CATALOGUES.

OILING SYSTEM—Bulletin No. 02 from the Pittsburg Gauge & Supply Co., 30th St. and Liberty Ave., describes the White Star continuous oiling system. A Corliss engine is shown equipped with this system and an oil economy of 50 to 80 per cent. is guaranteed. Oil filters, drain tanks, oil pumps, sight feeds, etc., are illustrated and described. The prices are also included.

SCRAPERS—Illustrated booklet from the Worcester Brush & Scraper Co., 24-26 Southbridge St., Worcester, Mass., describes Criss-Cross Boiler Tube Cleaners, flue brushes, gauge glass cutters etc.

PACKINGS—The General Supply Co., 115-125 Adelaide St. west., Toronto, have issued a 48-page catalogue of interest to engineers. List prices are included on all specialties such as valve stem twist packing, square flax,

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and the rivers and streams are filled with ice and other floating impurities, will it find you with your pumps and condensers unprotected? BETTER LOOK INTO THIS, and install a

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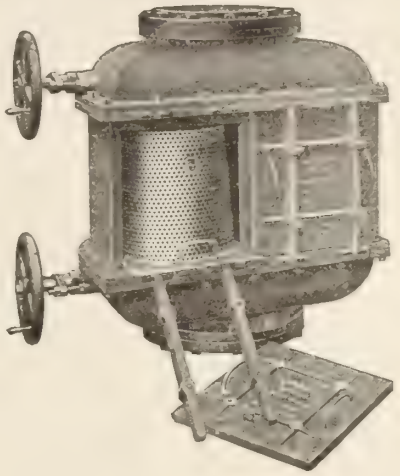

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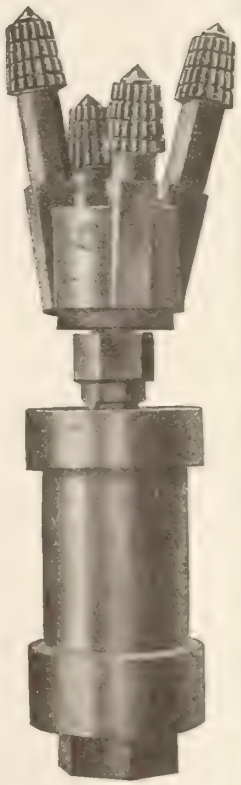

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BOILER COMPOUNDS—The Woodward [illegible] Compounding Co., 89 Cannon St., West, Hamilton, have issued a booklet on the scientific treatment of boiler troubles, which they are mailing to engineers interested in removing and preventing incrustation or [illegible] in steam boilers.

WATER TURBINES—Escher Wyss & Co., Zurich and Ravensburg, have issued a new catalogue of water turbines, Zoelly turbo-[illegible] and Zoelly marine turbines. The total number of water turbines of all kinds built by Escher Wyss & Co. to the end of June, 1910, was 4,664, with a total output of of 1,642,000 h.p.

LUBRICATION—Pamphlet No. 210 from Detroit lubricator Co., Detroit, describing style "C" Lubricator.

WATER COLUMNS—The Reliance Guage Column Co., Cleveland, Ohio. Circular. Devoted to the Reliance safety water columns, which are made in both the low and the combined high and low water alarm types.

BABBITT METAL—Magnolia Metal Co., 15 Bank St., New York City. Pamphlet. Gives briefly the advantages of the Magnolia metal, with the results of tests made on Magnolia and genuine Babbitt metal.

WATER SOFTENER—The Dearborn Drug & Chemical Works, McCormick Building, Chicago, Ill. Booklet entitled "Treatment of Boiler Feed Waters." Covers the whole problem of treating boiler feed waters and shows a number of boiler tubes that have been corroded both externally and internally.

CALENDAR—J. R. Baxter, 182 St. Antoine St., Montreal, have published an attractive calendar for 1911, which they are sending to [illegible] customers and friends.

MARINE ENGINEERS CELEBRATE.

The seventh annual ball of Council No. 4 National Association of Marine Engineers, which was held on Feb. 8 in Kingston, was a gratifying success in every sense of the word. The committee are congratulating themselves on the large attendance, the good time that 650 people in attendance had and the general swing with which everything seemed to go.

The decorations were suggestive of the profession. Harvey Milne had a display of gasoline engines on the stage. There were also several other models of engines. T. J. S. Milne, National Grand President of the N. A. and M. E. delivered a brief address.

The dances were started in a manner quite in accordance with the discipline of steamboat men. The stroke of the bell announced the start of each dance and in response to the gong, Crosby & O'Connor's orchestra of six pieces struck up the strains of music suitable for dancing.

The committees in charge were:—

Managing—W. H. Taylor, Chairman; A. E. Kennedy, L. E. Spencer, D. A. Sinclair, J. B. Lapan, P. J. Norris, R. Mulkin, Sylvester Murray, (secretary.)

Entertaining—M. R. Taylor, Alex. Milne, James Gillie, George Boyd, O. J. Hickey, Thomas Hazlett, W. C. Spencer.

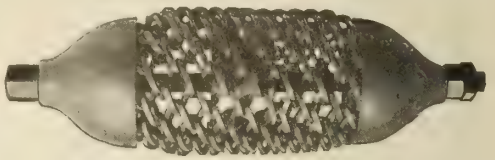
George Fleming, President.

T. J. S. Milne, National Grand President.

CRISS-CROSS BOILER TUBE CLEANER.

In the accompanying illustration is shown the Criss-Cross Boiler Tube Cleaner. It is constructed of high carbon steel wire and has a multitude of cleaning edges placed at right angles to the surface of the tube.

The spring formation of the cleaner adjusts it so as to allow an excellent bearing and it works well in both directions. The crumpled scale is discharged from the tube when the cleaner is drawn back as well as when pushed forward.



Criss-Cross Boiler Tube Cleaner, Worcester Brush & Scraper Co., Worcester, Mass.

Another point about the Criss-Cross Cleaner is that it will polish new tubes and also restore the surface of such as have been defaced.

The Criss-Cross Cleaner is manufactured by the Worcester Brush & Scraper Co., 24-26 Southbridge St., Worcester, Mass.

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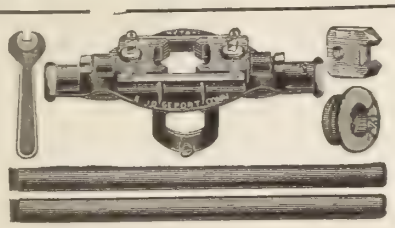
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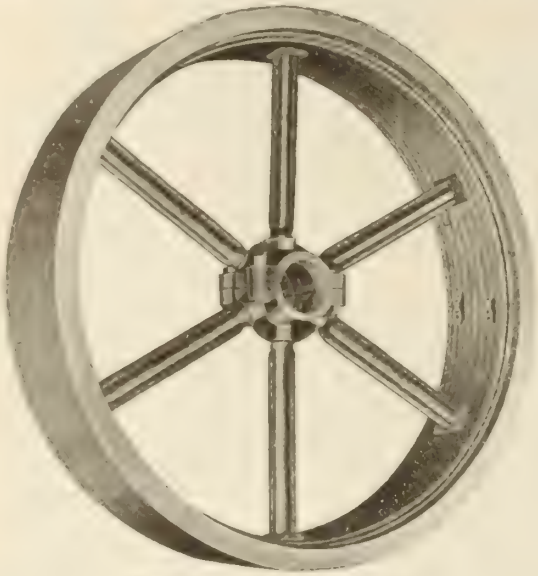

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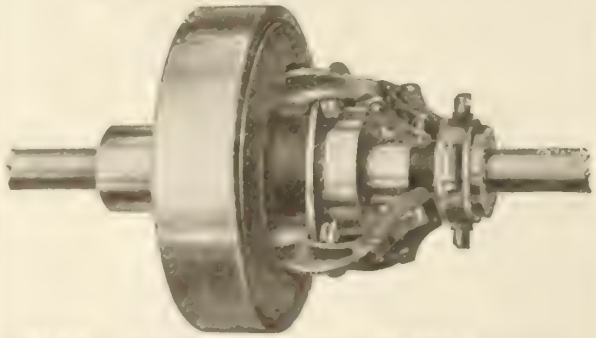

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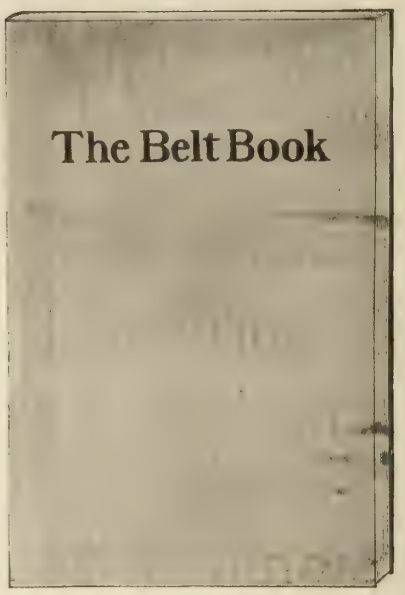

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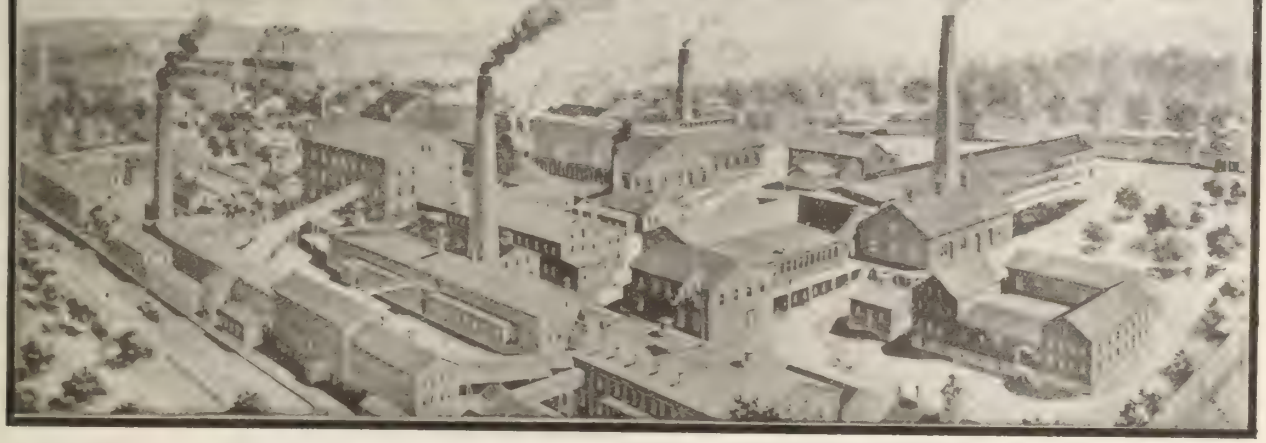

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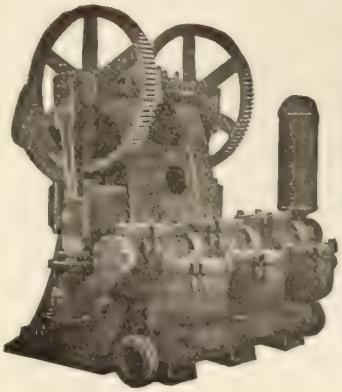

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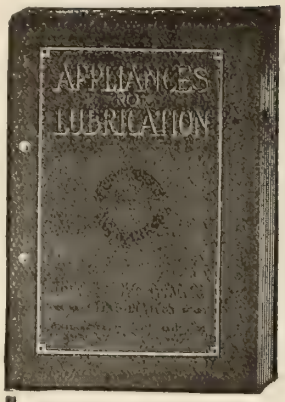

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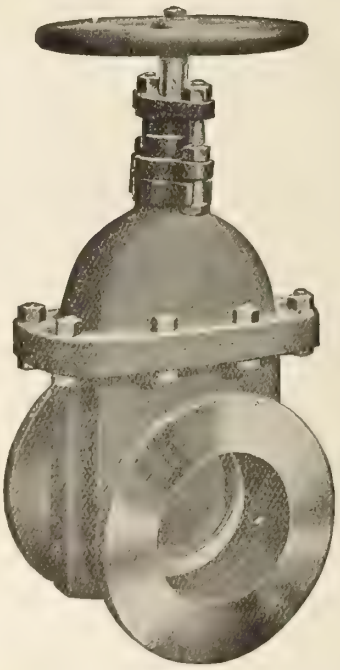

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W. C. McGHIE,
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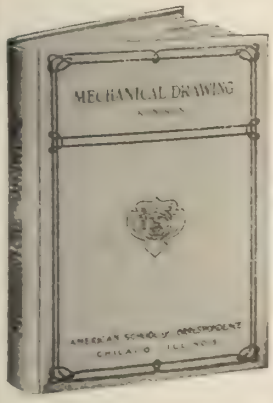

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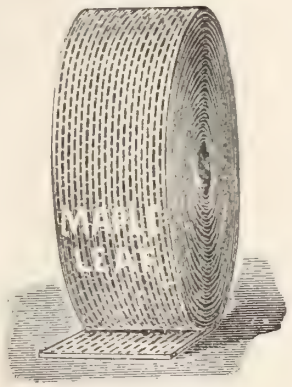

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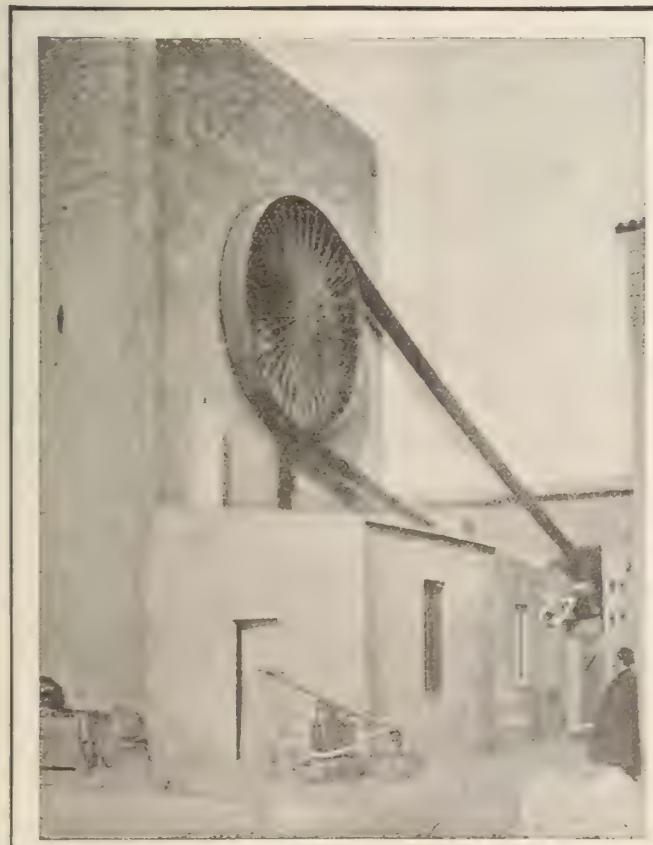

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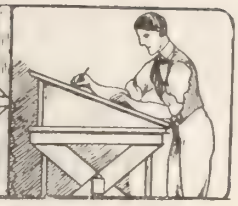

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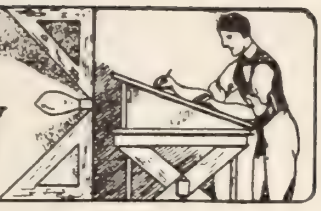

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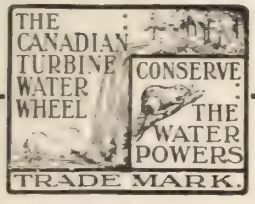

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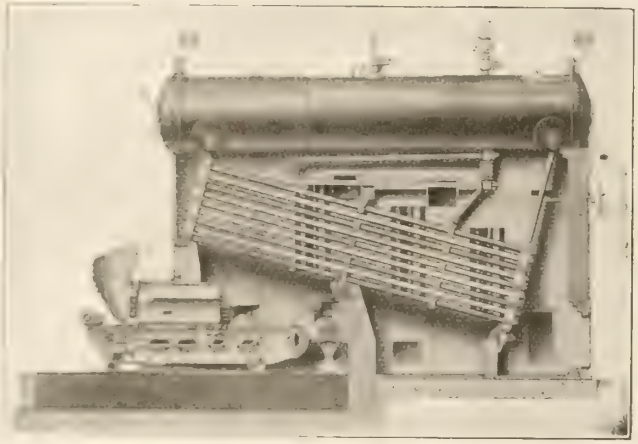

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Cleveland & Cameron, Vancouver, B.C.
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E. J. Greenstreet, Toronto
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Marchand & Donnelly, Ottawa, Ont.
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J. M. Shanly, Montreal.
Standard Engineering Co., Toronto

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Conveyor Machinery.

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Jno. McDougall Caledonian Iron Works, Montreal

Cork Insulation.

Canadian Fairbanks Co., Ltd., Montreal
Linde British Refrigeration Co., Montre

Cotton Hose.

Quaker City Rubber Co., Philadelphia, Pa

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Canadian Fairbanks Co., Ltd., Montreal
Manitoba Bridge & Iron Works Limited, Limited
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Babcock & Wilcox, Montreal
Jno. McDougall Caledonian Iron Works Montreal

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Michigan Lubricator Co., Detroit

Crank Pin Oilers.

Lunkenheimer Co., Cincinnati, Ohio

Cross Head Pins.

Michigan Lubricator Co., Detroit

Cross Head Pin Oilers.

Lunkenheimer Co., Cincinnati, Ohio

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Canadian Fairbanks Co., Ltd., Montreal
The Wm. Hamilton Co., Peterborough

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Julian-d Este Co., Boston, Mass.
H. L. Peiler & Co., Montreal
Power Economies Ltd., Montreal
Watts Regulator Co., Lawrence, Mass

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Allis-Chalmers-Bullock, Ltd., Montreal

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Jno. Inglis Co., Ltd., Toronto

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Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

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Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montre

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Electric Power Instalations.

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Co , Hamilton

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Co , Ltd , Montreal,
use Co , Hamilton

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, Galt.
Works Co , Brantford

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Engines, Corliss.

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Engines, Gas and Gasoline.

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Co , Hamilton
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London, Ont
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e Works Co , Brantford

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, Brantford

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Ltd Montreal

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Montreal
Manchester
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Darling Bros., Montreal
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Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

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Reliance Gauge Column Co., Cleveland Ohio

Feed Water Analyser.

Drug and Chemical Works,
C. C. Snowdon, Calgary

Feed Water Heaters

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Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
C. A. Dunham Co., Ltd., Toronto
Goulds Pump Co., Montreal.
The Wm. Hamilton Co , Peterborough.
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Jno. McDougall Caledonian Iron Works, Montreal

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The Wm. Hamilton Co., Peterborough

Gears, Mortise.

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Gears, Reducing

Jno. McDougall Caledonian Iron Works, Montreal

Gears, Spur Level.

Manitoba Bridge & Iron Works Limited, Winnipeg

Gears, Worm.

The Wm. Hamilton Co., Peterborough

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Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Governors.

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C. A. Dunham Co., Ltd. Toronto

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Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

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Butterworth Foundry Co., Ottawa
Canadian Steam Boiler Equipment Co., Toronto
Diamond Grate Bar Co., Berlin, Ont.
The John Inglis Co., Ltd., Toronto
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal

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Standard Engineering Co., Toronto.

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Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peterboro Lubricator Co., Peterboro, Ont
Power Economies, Ltd., Montreal

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Power Economies, Ltd., Montreal
C. C. Snowdon, Calgary

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Jos. Dixon Crucible Co., Jersey City
Power Economies, Ltd., Montreal
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Michigan Lubricator Co., Detroit
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American Lubricator Co,, Detroit

Lubricators, Plain.

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C. A. Dunham Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio

Lubricators, Steam,

American Lubricator Co., Detroit

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Meters, Electric

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto.

Meters, Water

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Jno. Inglis Co., Ltd., Toronto
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Canadian Fairbanks Co., Ltd., Montreal
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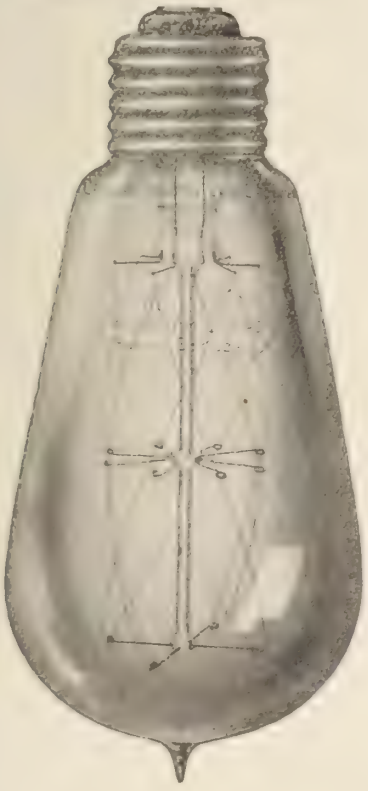

¶ The Hydro-Electric Engineers when testing the Tungsten Lamps sent in as samples, found that 200 revolutions a minute broke every Tungsten lamp EXCEPT the Kolloid-Wolfram, and at 500 revolutions a minute the Kolloid-Wolfram was still brightly burning.

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[illegible]

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Canadian Steam Boiler Equipment Co Toronto
Darling Bros., Montreal
C. A. Dunham Co., Ltd., Toronto
Eadie-Douglas, Ltd., Montreal
[illegible]
H. L. Peiler & Co., Montreal
[illegible] Ltd., Montreal
Standard Engineering Co., Toronto

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Dearborn Drug and Chemical Works, Chicago
[illegible]

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[illegible]

Packing, Metallic.

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[illegible] Co., Montreal
[illegible] mies, Ltd., Montreal
Quaker City Rubber Co., Philadelphia, Pa
Rhodes Improved Metallic Packing Co., Ltd., Montreal

Packing, Rod.

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Packing, Sheet,

Garlock Packing Co., Hamilton, Can
Quaker City Rubber Co., Philadelphia, Pa
Turner Brothers, Canada, Ltd., Montreal

Packing, Steam,

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Quaker City Rubber Co., Philadelphia, Pa
Turner Brothers, Canada, Ltd., Montreal

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Montreal
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Pipe (Second-Hand.)

[illegible]

Pipes, Water.

[illegible]

Piping, Steam,

Babcock & Wilcox, Montreal
[illegible]

Planimeters.

[illegible]

Plate Work.

[illegible]
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Jno. McDougall Caledonian Iron Works, Montreal

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Canadian Fairbanks Co., Ltd., Montreal
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Lunkenheimer Co., Cincinnati, Ohio
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Michigan Lubricator Co., Detroit
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Pumps, Steam

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Jenckes Machine Co., Sherbrooke, Que.
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Waterous Engine Works Co., Brantford.
The Wm. Hamilton Co., Peterborough

Tanks, Steel.

The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
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Escher, Wyss & Co., London, Eng

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Escher, Wyss & Co., London, Eng

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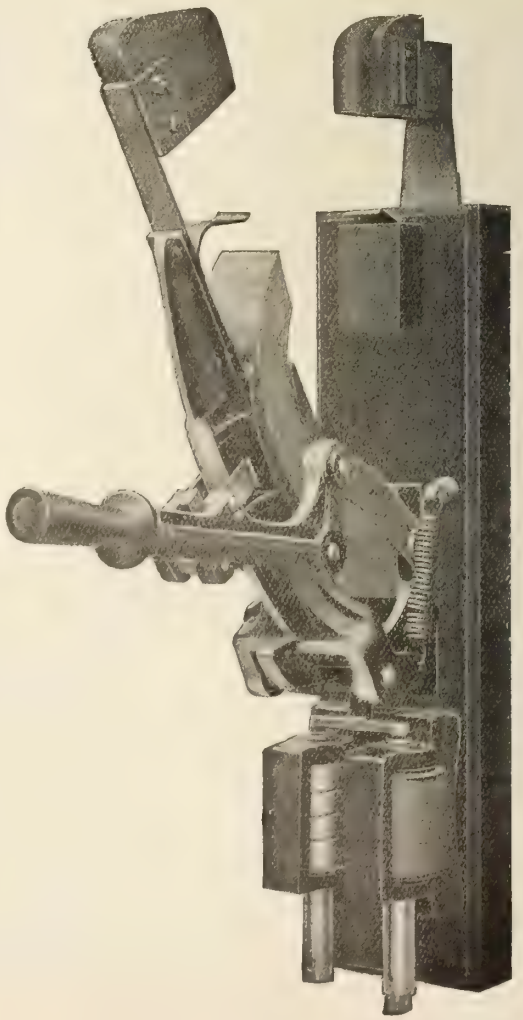

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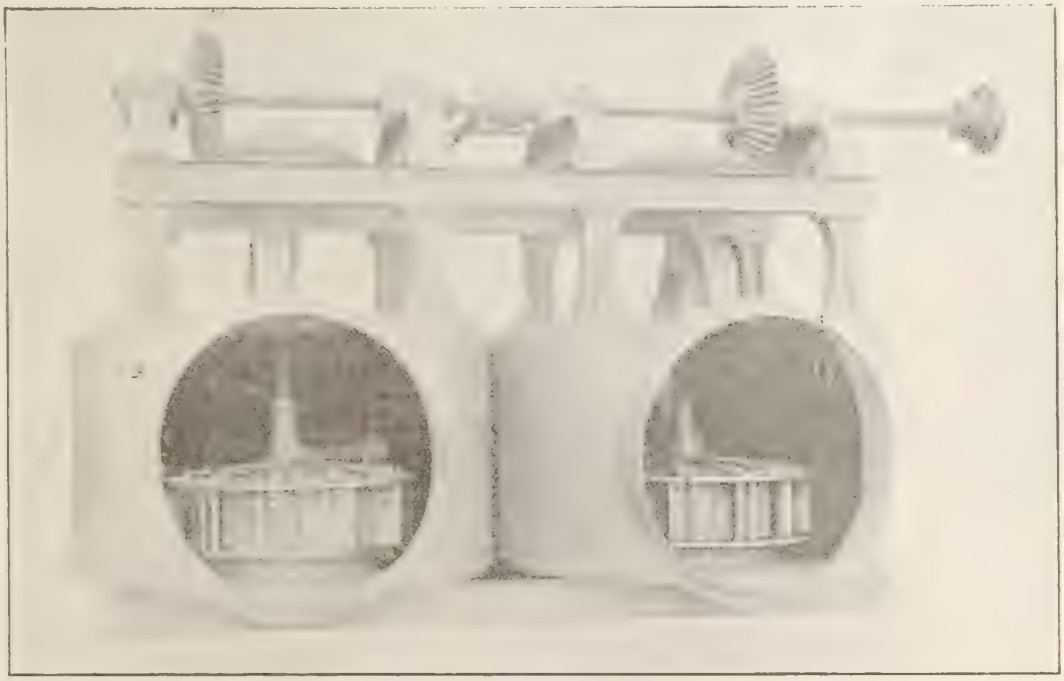

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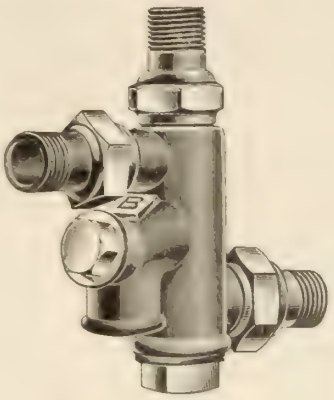

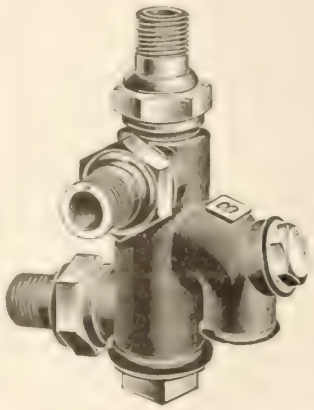

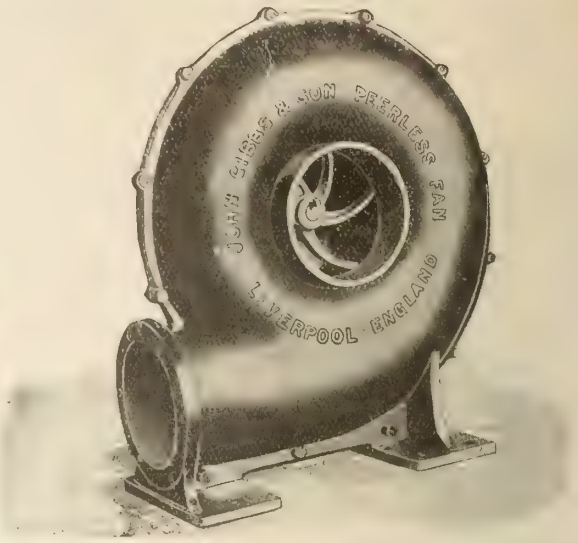

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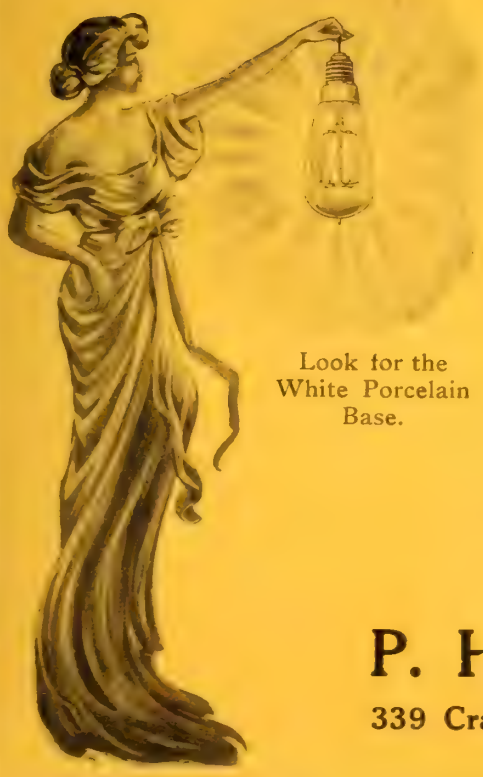

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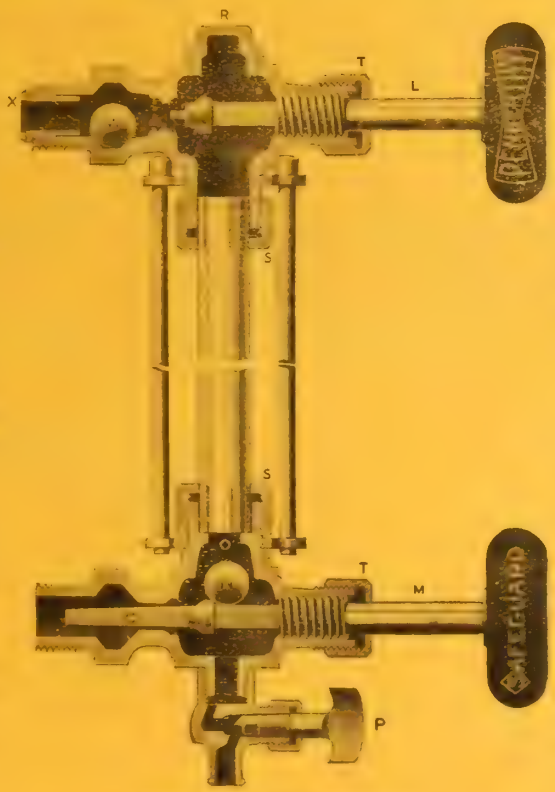

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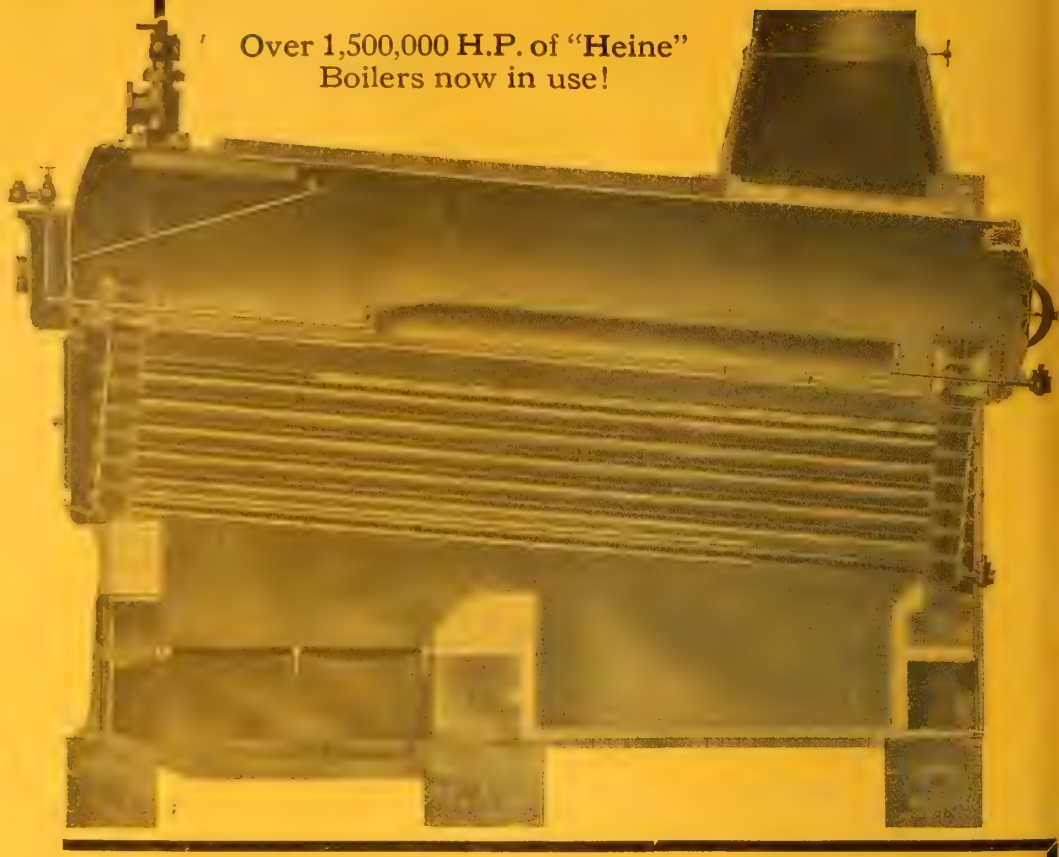

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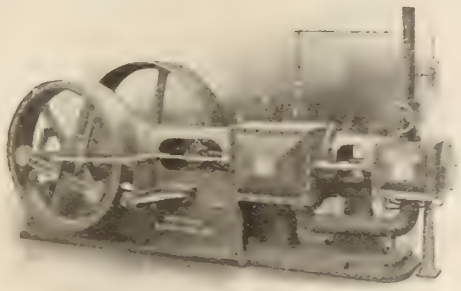

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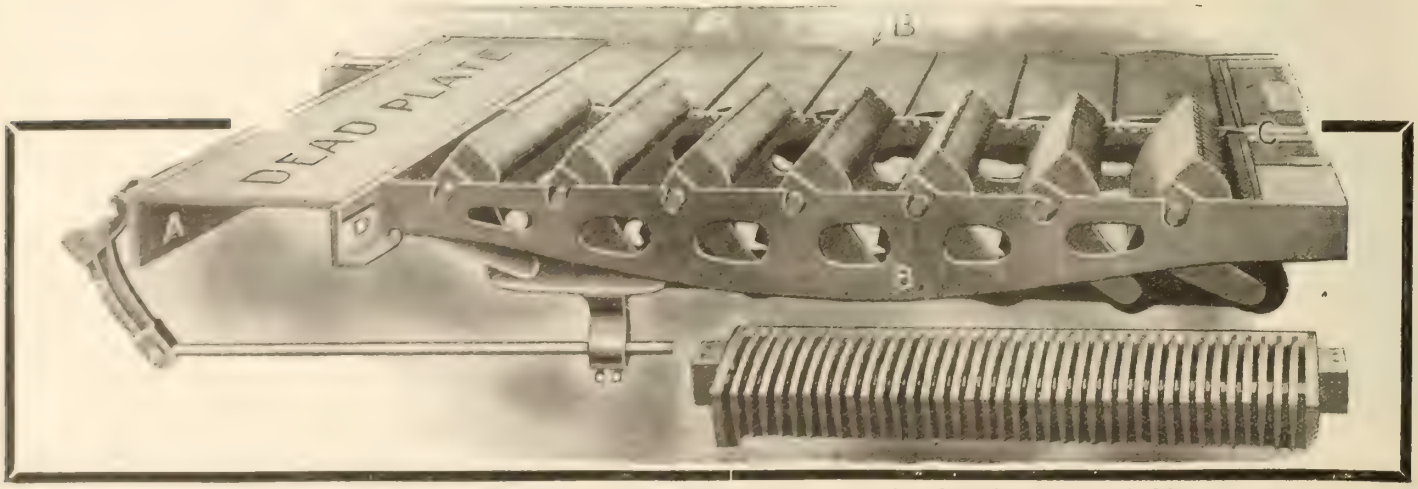

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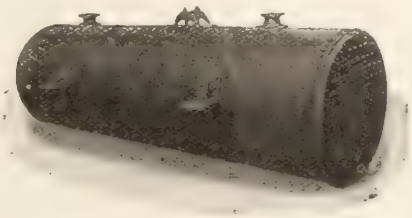

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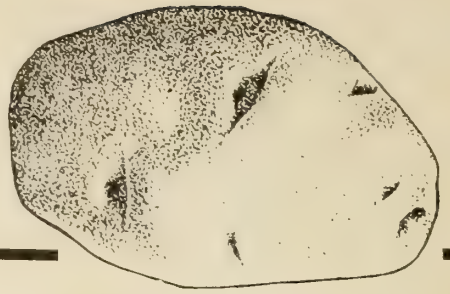

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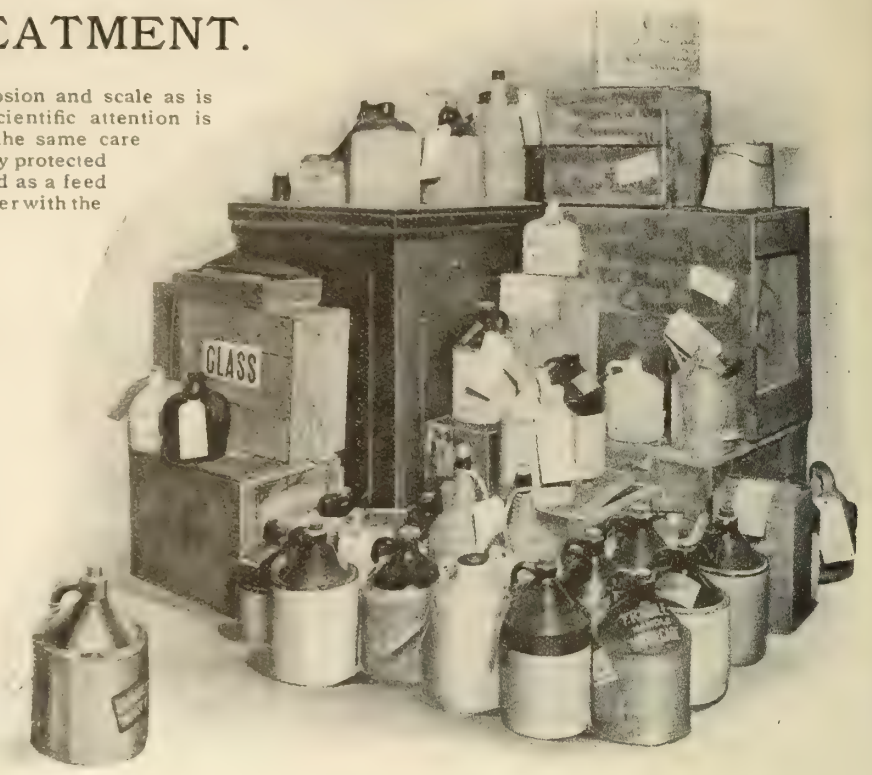
Do not wait for scale to form or tubes to burn out, your pumps to choke or your feed pipes to fill up before you take precautions. Proper care means better and longer service at a less expense in full

The DEARBORN Treatment is a huge saving.

Send us sample gallon of water and test will be made without cost to you.

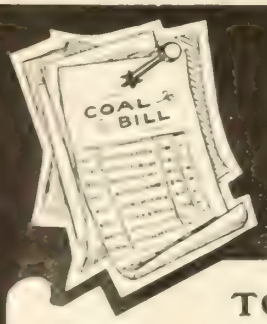


Dearborn Drug and Chemical Co.

GENERAL OFFICES AND LABORATORY: CHICAGO.

EASTERN OFFICES: 299 Broadway, NEW YORK.

BOILER SCALE IS A LUXURY!



TO PEOPLE WHO USE LIVE STEAM IN MANUFACTURING PROCESSES

Have you been putting up with scaly boilers, wasting fuel, shutting down once in a while to pound scale out of boiler tubes? Have you been doing this because you fear boiler compounds might contaminate your steam? Let us tell you this:

There is a man in Toronto engaged in a business where live steam direct from the boiler is brought into contact with fine white silk fabric. He says the slightest presence of injurious chemicals in that steam would ruin the He uses Red Star Compound, and he says that:

RED STAR Boiler Compound

POSITIVELY DOES NOT CONTAMINATE STEAM IN ANY WAY

We can demonstrate to your absolute satisfaction these two things: 1. That Red Star Boiler Compound will free any boiler from old scale and prevent absolutely the formation of any new scale. 2. That Red Star Boiler Compound will not contaminate steam; and that it can be used with perfect safety in plants where live steam is used in cooking foodstuffs.

60 Days' Free Trial Send us a gallon sample of your feed water, we will analyze it, make up and send you a quantity of Red Star Compound. Use it for sixty days, if it is not just as we claim, ship it back at our expense. If it is satisfactory send us a check for the amount of invoice Could ANY offer be fairer than this?

Write for Booklet Giving Full Particulars—Write Now

LAKE ERIE BOILER COMPOUND CO.

11 COLBORNE STREET, - - - - TORONTO, CANADA

RED STAR COMPOUND KILLS SCALE!

THE POWER HOUSE

R

The advertiser would like to know where you saw his advertisement—tell him.

Any Scale in Your Boilers?
Any Grease in Your Boilers?
Any Corrosion in Your Boilers?

Would you like to be rid. once and for all, of these afflictions, and all the losses, troubles and dangers resulting from them?

WE WILL GUARANTEE A PERMANENT CURE for any of these boiler diseases, or for all three together.

THE BIRD-ARCHER BOILER COMPOUNDS

are specific remedies for all internal boiler disorders. They will remove the most tenacious scale and prevent the formation of new; they will cleanse the plates and tubes of all grease and stop further accumulations: they will immediately prevent all forms of corrosion no matter how bad the feed water. THESE THINGS WE GUARANTEE.

They will not cause priming or foaming; they will not injure the boiler fittings, gaskets or packings; they will not "cut" the cylinder lubricants. THESE THINGS WE LIKEWISE GUARANTEE.

You don't risk a penny in trying Bird-Archer's Boiler Compounds, because there is nothing to pay unless the compound "makes good" in EVERY respect.

Write for our book, "Boiler Troubles and Their Prevention." Send us at our expense a gallon jug of your feed water for free analysis. Give us a trial order and you'll never worry your head about internal boiler troubles again.

The Bird-Archer Company

90 West Street, NEW YORK CITY

Canadian Representatives: LOWDEN & MEAD, 13 Bleury Street, MONTREAL

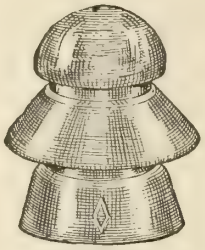
THESE TRADE
ESTABLISHED STA

RUBBER COVERED · TRADE ADANAC MARK · WIRES AND CABLES

THE WIRE & CABLE COMPANY

MADE IN CANADA · TRADE DUNCAN MARK

DUNCAN SOCKETS AND CUTOUTS



DIAMOND GLASS INSULATORS

AMERICAN CROSS-ARM CO. · ASK YOUR DEALER FOR · WALWORTH NEVILLE · CROSS-ARMS · CHICAGO

DRY BATTERIES

TRADE MARK

"Chloride Accumulator"

REGISTERED SEPTEMBER 11, 1894

"Exide" STORAGE BATTERY

HUBBELL

HUBBELL SPECIALTIES

QUALITY

Each Trade-Mark is Your Guarantee of Quality and Economy

ARROW ELECTRIC SWITCHES

TRADE FARADAY MARK

SKELETON AND ENCLOSED SIGNAL BELLS

BRYANT · SUPERIOR WIRING DEVICES

(Reg. U. S. Pat. Off.)

CONDUITS COMPANY LIMITED · TORONTO, CANADA

LORICATED AND GALVADUCT CONDUIT

"COLUMBIA"

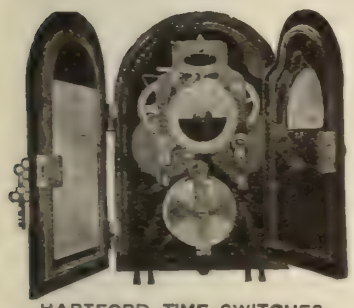
METAL PANEL AND CUTOUT BOXES

FIRE ALARMS · THE NORTHERN ELECTRIC AND MFG. CO. LIMITED · TELEPHONES SUPPLIES

THE Northern AND MANUFACT

MONTREAL TORONTO WINNIPEG ADDRESS O

MARKS DENOTE
NDARDS OF QUALITY



HARTFORD TIME SWITCHES

BROOKFIELD

1872 EDWARDS

EDWARDS & CO. HOUSE GOODS

WEATHERPROOF TRADE WACCO MARK WIRES AND CABLES

THE WIRE & CABLE COMPANY

WARD LEONARD

RHEOSTATS AND CONTROLLERS

D&W

D. & W. FUSES AND CUTOUTS

TRADE P&B MARK

P. & B. INSULATING COMPOUNDS

CH

CROUSE-HINDS CONDULETS AND PANEL BOARDS

IMPROVED BLUE BELL BATTERY

SERVICE

The Large Assorted Stocks in Our Houses, Allow Immediate Shipment on all Standard Material

Inter-phones

UNGST DAYLIGHT OLIER

MAZDA LIGHTING FIXTURES

THOMAS QUALITY RELIABILITY

THOMAS INSULATOR

PERKINS SUPERIOR WIRING DEVICES

(Reg. U. S. Pat. Off.)

Electric

URING CO. LIMITED

THE NORTHERN ELECTRIC AND MFG. CO. LIMITED FIRE ALARMS TELEPHONES SUPPLIES

AREST HOUSE REGINA CALGARY VANCOUVER

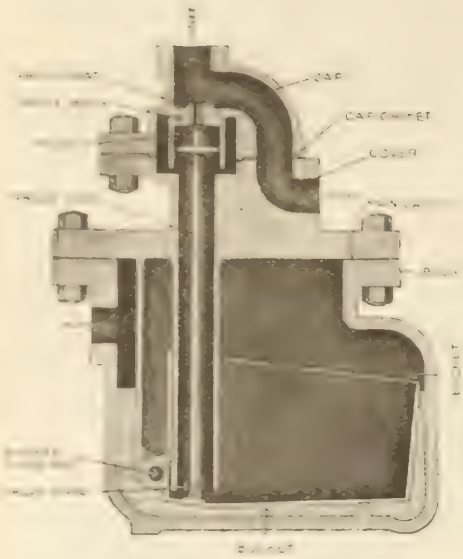
236

Trade Mark.

4/S

Registered

Here is What it is Worth to You
To Be Able to Test the Valve
In Your Steam Traps
Without Time or Trouble.



If the valves in your steam traps are leaking steam, and they probably are; if you have to take the time and trouble to take the trap apart to get at the valve, and the leak is 1/8 in. and your pressure 75 lbs., you are saying good-bye to at least 275 lbs. of coal every 9 hours. Why don't you buy

Strong Steam Traps

and know what is going on? Let us send you our catalog 14, explaining our valve testing without loss of time. Oh, yes! "On their merits alone we ask your patronage."

The Canadian Fairbanks Co., Limited

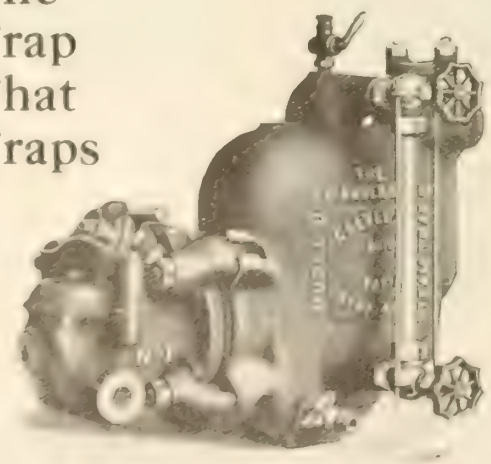
Montreal, Quebec, Canada

TORONTO ST. JOHN, N.B. WINNIPEG CALGARY VANCOUVER

The Anderson Improved Steam Trap

Discharges the Water AND Holds the Steam

The Trap That Traps



It is all that its name implies---a trap for steam from which steam **never** escapes, and water of condensation **invariably does.**

The body is constructed of close grained iron, with a valve which can be removed without disconnecting trap from pipes.

The valve and valve seat, of phosphor bronze, are simple in construction and easy of access.

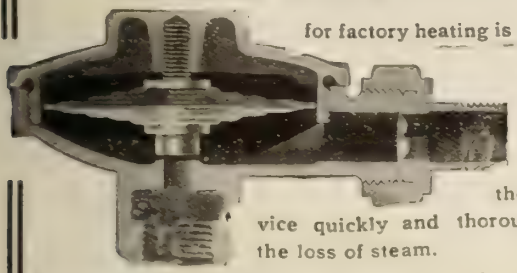
The Anderson will deliver exhaust water against any back pressure of five pounds less than the steam pressure at the trap.

THE V. D. ANDERSON CO.

West 96th Street, Cleveland, Ohio

The advertiser would like to know where you saw his advertisement—tell him.

DUNHAM RADIATOR TRAP

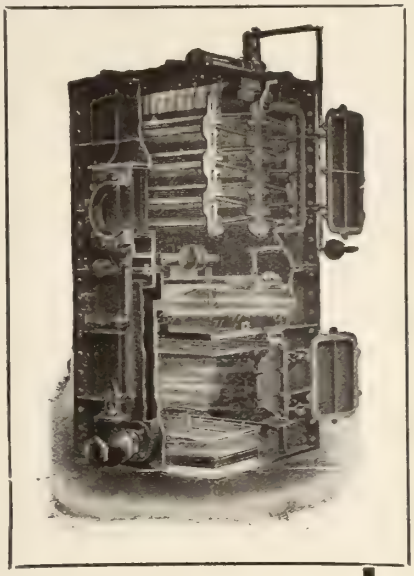


for factory heating is best. Try it on your large pipe coils or dry kiln radiation. It will drain the hardest service quickly and thoroughly without the loss of steam.

Catalogue "B" gives full particulars. Send for a copy to-day.

C. A. DUNHAM Co., Limited,
511 Continental Life Building, TORONTO.
—Branches—
Phoenix Building, Winnipeg, Man.; 157 Water St., Vancouver, B.C.

More Power at Less Cost !



Here's a proposition to diminish working costs that must surely appeal to YOU!

Will you investigate the merits of the

WEBSTER

Feedwater Heater, Purifier and Filter?

It makes use of all condensations and waste steam, and will positively rid your boiler of scale by removing all scale-forming elements from your feedwater. Using pure water means getting every ounce of power out of your boiler with a *smaller* amount of fuel.

Our descriptive literature has many points of interest for you! Send for it TO-DAY.

DARLING BROS., LIMITED
Montreal Toronto Winnipeg
Vancouver, B.C., Frank Darling, Agent

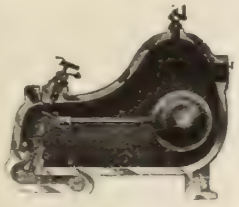
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St., MONTREAL, CAN

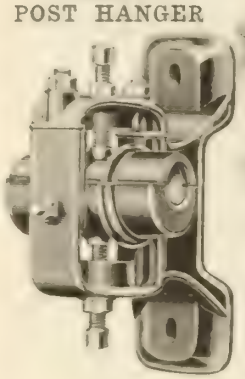
IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, CAN.

100% STEAM TRAP EFFICIENCY
¶ MOREHEAD STEAM TRAPS operate on a principle that insures the complete saving of the heat units represented in the condensation from the steam line returns.
¶ The condensation from any steam heating or power apparatus must be removed. The quicker the condensation is removed, the dryer and more effective will be the steam lines. The condensation is pure water and HOT; it is the greatest extravagance to waste it.
¶ The most effective way to utilize the heat content is to deliver it into the boiler before it vaporizes. In no other manner can the condensation be handled so quickly and with the same economy as with a Morehead Trap.
¶ All about it in the "Trap Book." — Write.
MOREHEAD MFG. COMPANY
DETROIT, MICHIGAN.
¶ This illustration shows one of eight Morehead Steam Traps installed at the plant of the McKeesport Tin Plate Company, McKeesport, Pa.

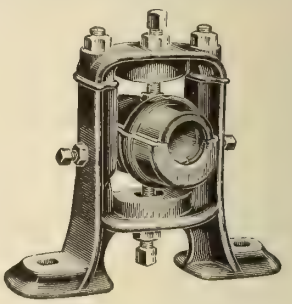
"I'LL MAKE ASSURANCE DOUBLE SURE AND TAKE A BOND." Shakespeare

BOND
DOUBLE SURE TRANSMISSION

"BOND" POST HANGER



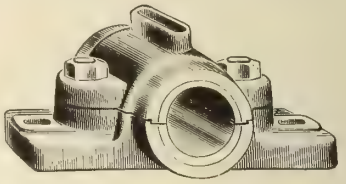
"BOND" UNIVERSAL PILLOW BLOCK

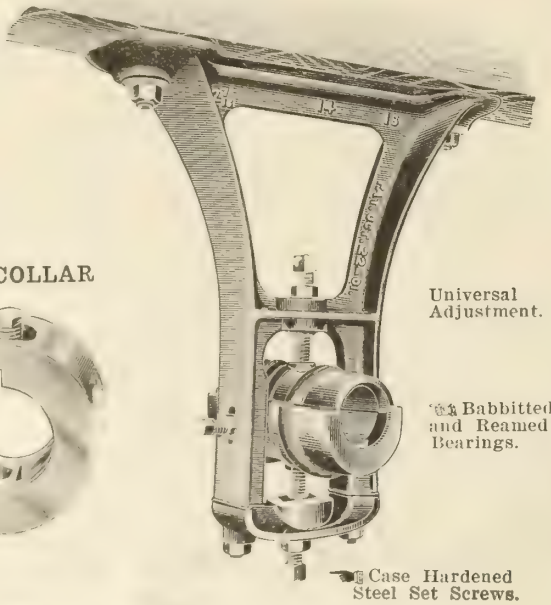


ALL BEARINGS BABBITTED AND REAMED.

"BOND" SOLID COLLAR

"BOND" CLAMP BOX



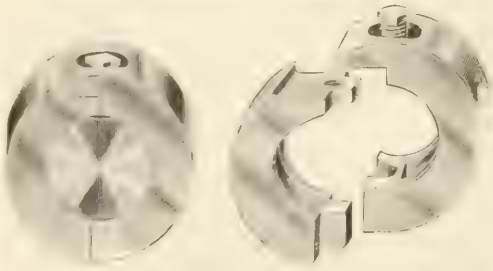


Universal Adjustment.

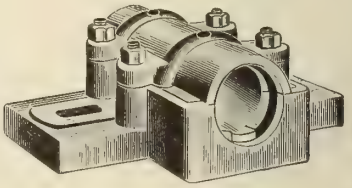
Babbitted and Reamed Bearings.

Case Hardened Steel Set Screws.

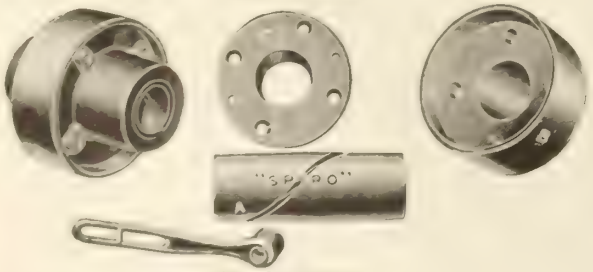
"BOND" SAFETY SPLIT COLLAR



"BOND" RIGID R. O. PILLOW BLOCKS

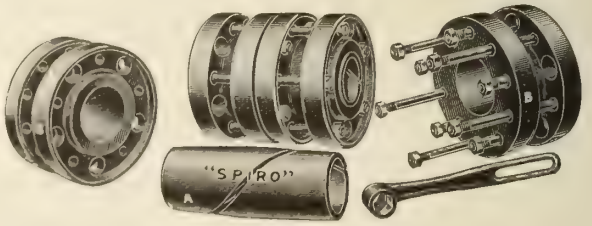


"BOND" PATENT SPIRO COMPRESSION COUPLING



Single Flange

"BOND" PATENT SPIRO COMPRESSION COUPLING



Double Flange A.—Sleeve. B.—Shells.

WRITE FOR CATALOGUE X

Manufactured by

Canadian Bond Hanger and Coupling Co., Limited

Alexandria, Ontario.

TIN 60c. NOT YET BUT SOON

IS PREDICTED

Users of "GENUINE" Babbitt are Confronted with a Serious Condition

WHY STAND FOR IT?

MAGNOLIA METAL

will sail rings around "Genuine" Babbitt at about half the cost per pound and then save probably as much more in the reduction of frictional resistance, in longer wear, less fuel, less oil, less liability to squash or "shut down" and less rebabbitting.

Engineers using Magnolia can spend their evenings at home and read the papers during the day.

Sounds Like Bragging. And it is

We have a right to brag, for we merely reflect the enthusiasm and high opinion of engineers and great scientists and governments and others in all parts of the world, and we don't believe in hiding our light under a bushel.

Now is the time of times to test Magnolia on the bearings where you believe that only "Genuine" Babbitt will work.

It is an erroneous idea if you think that Magnolia is a soft metal. Magnolia will withstand 19% greater pressure than "Genuine," and as we have frequently pointed out, it is frictional heat that causes squashing to which "Genuine" is very susceptible and Magnolia exceptionally immune, because possessing the lowest co-efficient of friction of any known metal with all of its correlated virtues and economies.

Please watch out for our ad., which will shortly appear, showing a remarkable test of Magnolia Metal by the United States Government using WATER as a lubricant. It is an eye opener.

Don't Hesitate. Order Magnolia Metal Now.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

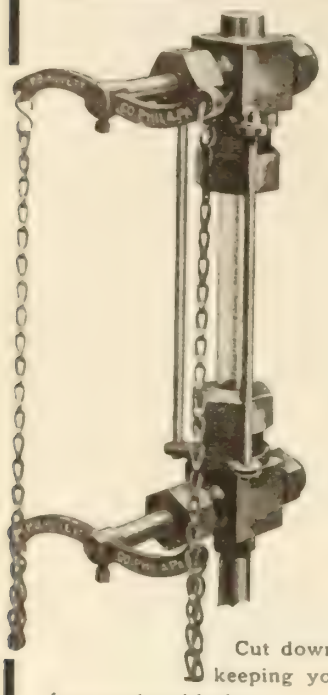
MAGNOLIA METAL CO.

No. 225 St. Ambroise Street, MONTREAL

New York Chicago

SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK, containing 680 pages, treating on over two thousand Engineering and Mechanical Subjects, brought up to date. We offer this valuable reference work at the very low price of 40c postage prepaid. Address Montreal office.

Accidents Will Happen



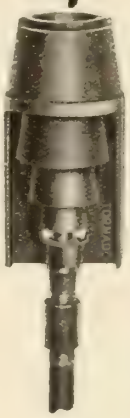
But their disastrous results can be minimized if you have installed a

"P.B.H." Quick Closing Water GAUGE

When a glass breaks, a pull of the chain shuts off both steam and water, less than a quarter turn fully opening and closing valves.

Made with extra heavy body of best steam metal.

SENT ON TRIAL



Cut down your fuel bills by keeping your boiler tubes free from scale with the

"Tornado" Steam Boiler Tube Cleaner

It works quickly, thoroughly and economically, and as the air injected by a small volume of steam has no moisture to wet the soot, it blows it out through the longest tubes.

SENT ON TRIAL

Mechanical perfection has been attained in the

"P.B.H." Quick Opening Self-closing Gauge Cock

(CUT BELOW)

guaranteed leakless for years. Is simple, efficient, economical, and quickly repaired.

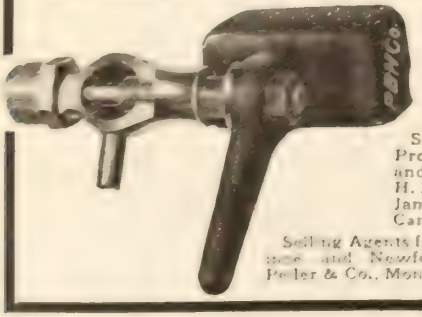
SENT ON TRIAL

Here are a trio of appliances that cannot fail to add to the efficiency of your shop.

Write for Catalogue.

The Paul B. Huyette Co., Inc.

1414 Betz Building, - Phildelphia, U.S.A.



Selling Agents for Western Ontario and North-West: Canadian Steam Boiler Equipment Co., 186 Queen E., Toronto.

Selling Agents for Province of Quebec and Eastern Ontario: H. L. Peiler & Co., St. James St., Montreal, Canada.

Selling Agents for Maritime Provinces and Newfoundland: H. L. Peiler & Co., Moncton, N. B.

Don't waste heat!

IF, as is an actual fact, thirty per cent. of the heat generated in the average plant is wasted, why not utilize this waste heat by installing a

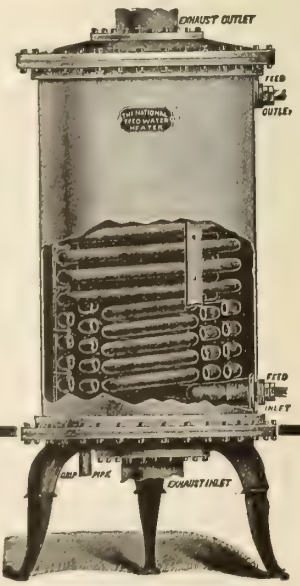
NATIONAL
Feed Water Heater?

It has no inside tubes to leak, no leaky straight tubes, no back pressure, and no contact of the water with shell or iron.

The "National"

is simple, practical and efficient and will surely reduce your fuel expense by providing your boiler with boiling water.

Ask for Our Free Booklet on Feed Water Heating.



The NATIONAL PIPE BENDING CO.

91 Lloyd St. New Haven, Conn.

No More Sand Filtration Here Since Blackburn-Smith Feed Water Filters And Grease Extractors Were Tried

The Ross Pumping Station, Aspinwall, Pa., is one of several supplying the City of Pittsburg with water. 3500 h.p. of boilers here depend for feed upon exhaust steam condensation containing oil and make-up water containing other floating impurities Four 8ft. x 9ft. sand filters connected tandem had previously been tried for purifying the water. These filters became so badly clogged in two or three days' service that they could not be washed thoroughly by reversing the flow. The man hole plates would have to be taken off and from six to eight inches of sand removed. The filters would apparently be working all right and in a few minutes the pressure on the pumps would jump from 25 to 30 pounds, as a result of which the filters had to be cut out entirely and dirty water pumped through the by-pass. Two No. 8 Blackburn-Smith Filters have been installed in parallel in place of the four sand filters and *there is no more trouble*.

One filter does the work of two of the other type, does it better and stays clean *much* longer.

Cleaning of one Blackburn-Smith Filter takes less than ten minutes, and as the other is always in service there is no plant interruption, nor does any dirty water get to the boilers. It is much easier, less expensive and in every way more satisfactory to renew the foul Terry cloths of a Blackburn-Smith Filter than to shovel the dirty sand formerly used, and the efficiency of the Blackburn-Smith Filter can always be depended upon.

If you saw what Blackburn-Smith Filters were doing in other plants you too would not hesitate to try them.

Ask for Booklet, "Feed Water Filtration."

Canadian Sales Agents

Eadie-Douglas, Ltd.

12-14 University St. - MONTREAL

Toronto Winnipeg Vancouver Ottawa Quebec

Cut Down Those Fuel Bills!

Why not use your exhaust steam to heat your feed water to the boiling point?

THE

OTIS

TUBULAR FEED WATER HEATER OIL SEPARATOR and PURIFIER

will do this for you rapidly and regularly whilst decreasing your fuel expense.

The "OTIS" will also furnish steam if required for further heating purposes, and extracts all oil from the exhaust.

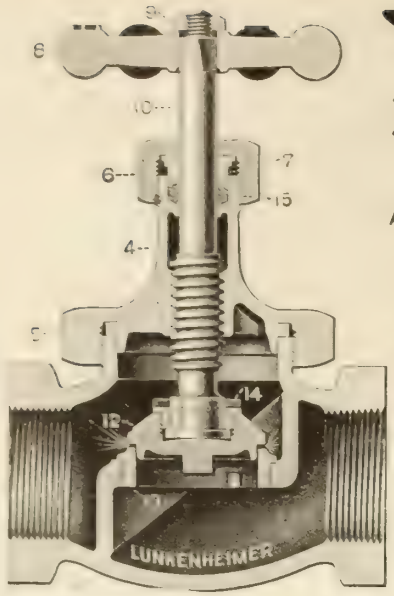
WE HAVE DESCRIPTIVE CATALOGUE WHICH IS YOURS FOR THE ASKING.

Write us to-day

The Stewart Heater Co.

189 Norfolk Avenue

BUFFALO, N.Y., U.S.A.



LUNKENHEIMER RENEWO VALVES

ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE

THE SEATING SURFACES CAN BE RE-GROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED, including the DISC and SEAT. The SEAT is SELF-CLEANSING and is made of a hard, close-grained nickel.

The bronze used contains a high percentage of copper and tin. The improved construction of the disc PRESERVES THE SEATING FACES and PREVENTS WATER HAMMER.

LUNKENHEIMER "RENEWO" GLOBE, ANGLE and CROSS VALVES are guaranteed for 200 pounds working pressure, and are made in sizes ranging from ¼ to 3 inches inclusive.

"Most supply houses sell them—yours CAN—if they DONT or WONT, tell US."

Write for catalog.

THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the World.

General Offices and Works:

CINCINNATI, OHIO, U.S.A.

NEW YORK —BRANCHES— CHICAGO

64-68 Fulton STREET 32 Dearborn St., Cor. Lake

LONDON, S.E.—35 Great Dover Street

Type "K"

Iron Body

Tested to 300 pounds hydraulic pressure.

Elliptical in design.

Double compensating bronze-faced discs.

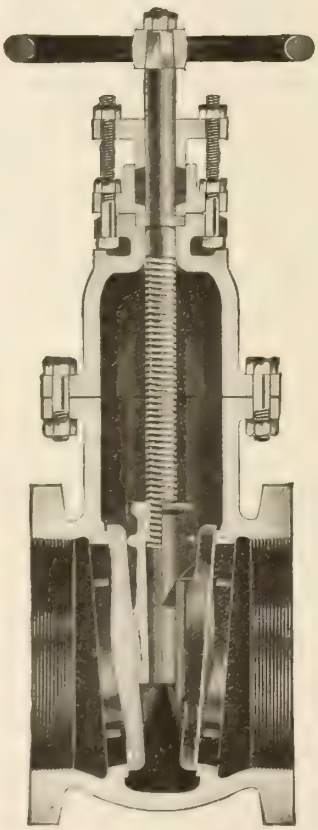
Can be re-packed while under pressure and wide open or closed.

Parts interchangeable.

Discs cannot jam.

Possess wide margin of safety.

Stocked by jobbers and dealers everywhere



Gate Valves

Bronze Mounted

Suitable for 125 pounds working steam pressure.

Design insures great rigidity and strength.

Heavy bronze seat-rings screwed into body and renewable.

Bronze disc-rings forced into double grooved recesses in discs.

Can be operated in any position.

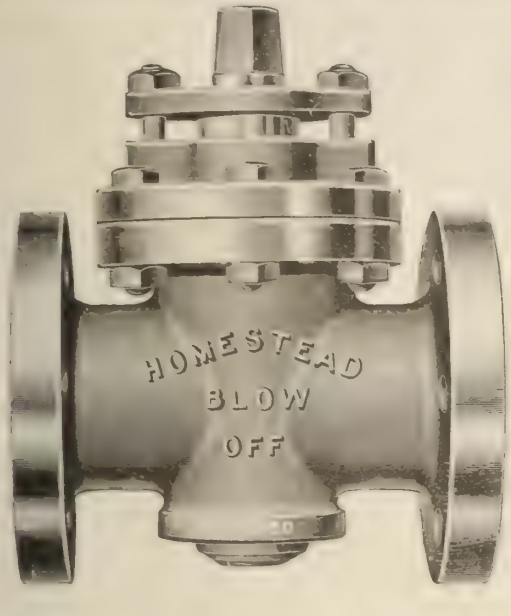
Handsome appearance.

Dependable in service.

SEND for TYPE "K" Booklet

JENKINS BROS., Limited, Sole Manufacturers

103 St. Remi Street - - - MONTREAL



Homestead Valves

WILL SAVE YOU MONEY

THEY are the most durable, easily and quickly operated valves made. Homestead Valves do not leak under the highest known air or hydraulic pressure, and they have a special device which locks when closed so that they cannot jar open.

The Seat is absolutely protected from wear when the pressure passes through, and there is no friction in the seat while plug is turning.

A quarter turn opens or closes the valve—no waste of time or energy. Why not write for our booklet to-day?

Homestead Valve Mfg. Co.
Works: HOMESTEAD, PA.
P.O. Box 1754, Pittsburg

Engines have been wrecked because the assistant opened the throttle when he *didn't know* that the engine was temporarily out of order.

Men have often been badly scalded because some one who *didn't know* turned on the steam.

Machines have often been seriously damaged because a switch was thrown when a machine was undergoing repairs.

To avoid these and similar accidents, the makers of the Nelson Valves have designed the

NELSON DANGER SIGNS

which they will mail free to all men who can use these signs to protect life or property.

Signs are 6 inch dia., printed both sides in red ink, like the above, but *three times larger.*

We send them free because we know you will value them enough to keep them, and because the name Nelson on the envelope in which we send them will remind you of the Nelson Valves, built by men who appreciate the *Engineer's Position*, and who make valves from an *Engineer's Standpoint.*

WRITE PLAINLY

Nelson Valve Company
Philadelphia, Pa.

Send to me package of Nelson Danger Signs, without cost, per your offer.

Name.....

Name of Plant .....

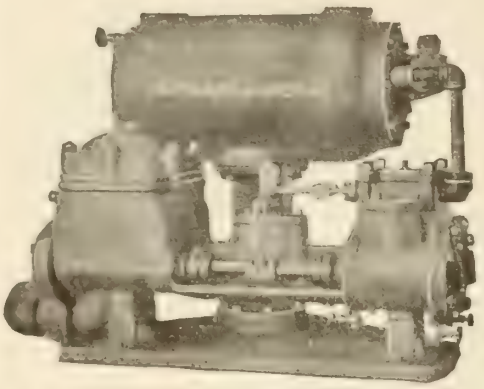
Street .....

City .....

State .....

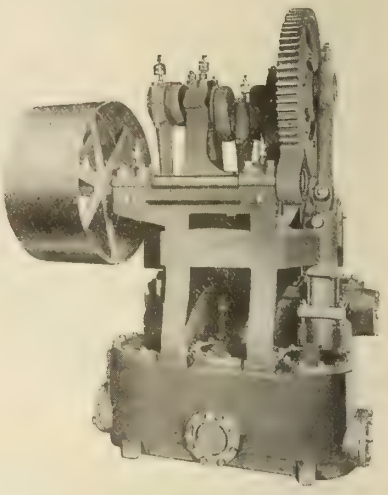
STEAM AND POWER PUMPS

OF EVERY DESCRIPTION

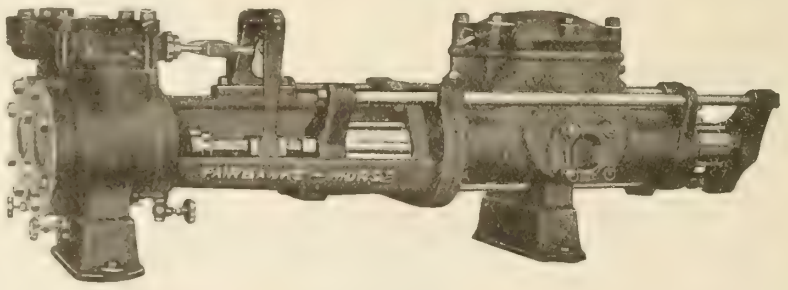


Duplex Automatic Feed Pump and Receiver.

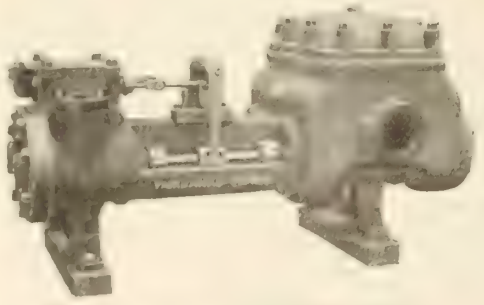
Profit by Our Experience



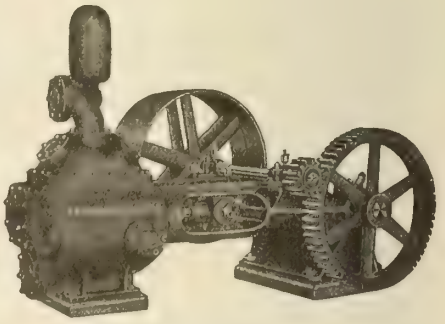
Triplex Power Pump.



Duplex Outside End Packed Plunger Pump



Fairbanks-Morse Duplex Piston Pattern
Low Service or Tank Pump.



Fairbanks-Morse
Duplex Power Pump.

Are you interested in a pump of any description, for any duty? We are manufacturers of, and selling agents for, a great variety of pumps, some of which are here represented. If you have not in mind the size and type of pump you require, we are prepared to figure upon your particular requirements and to suggest what would be most suitable for your work. In a word, we are at your service, and in order that we may make an intelligent recommendation, kindly give us full information as to your conditions and obtain the benefit of our expert opinion free.

The Canadian Fairbanks Co., Limited

Fairbanks Scales—Fairbanks-Morse Gas Engines—Safes and Vaults.

Montreal Toronto St. John, N.B. Winnipeg Saskatoon Calgary Vancouver

GARLOCK

Packings

are guaranteed to give satisfactory service when supplied by us with a knowledge of the conditions under which the packing is to be used.

TRADE MARK

We make and sell different grades of packing for different purposes.

Every grade we make is the best that can be manufactured for its particular purpose.

And, quality considered, GARLOCK Packings are the cheapest you can buy.

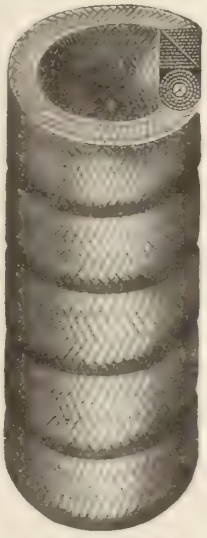
Write to-day for a GARLOCK Catalogue.

The Garlock Packing Co.

Toronto HAMILTON Montreal

Pioneers in the Packing Business.

"This BOOK Raised My Wages"



"Special"

When an engineer gets a Certificate, his wages go up. Let us send you a book of "Questions and Answers to Engineers' License Examinations." This book has helped hundreds of engineers in the "States" to pass License Examinations. You can have a copy absolutely FREE, if you go to your dealer's and simply look at

DANIELS'

P.P.P. ROD PACKING

The "sliding wedges" and "compressible cushion" adjust the bearing on the rod to the steam requirement, whether it be 300 pounds or but 5 pounds.

Scientific tests show savings of hundreds of dollars, yearly, in power cost.

How to get the Hand-book FREE

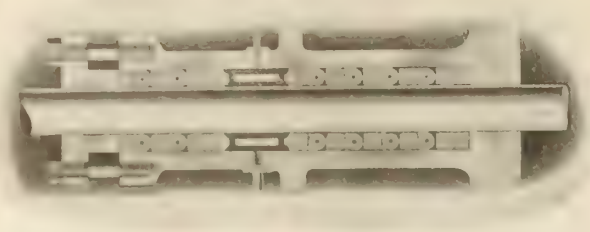
Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and *look* at Daniels' P.P.P. Packing.

YOUR NAME .....
ADDRESS .....
EMPLOYED BY .....
HORSEPOWER OF ENGINE .....
KIND OF PACKING USED .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24C.

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to dealer we name. Please do not call for book until we notify you.

Quaker City Rubber Co.

Philadelphia, Pa., U.S.A.



An Ammonia Rod Packed with Tandem Sets of Daniel's P.P.P. Ring Packing.

Ammonia Fumes are Dangerous

Ammonia is a poisonous gas. The constant breathing of even a small quantity is detrimental to health.

Then, too, the loss of ammonia, through leakage, is expensive.

Don't risk your health nor lose money by the use of ordinary ammonia rod packings.

DANIEL'S ROD PACKING P.P.P. FOR AMMONIA

is constructed on the famous "Daniel Idea" of sliding wedges and a compressible cushion. The materials used are specifically adapted to the purpose, and specially treated to secure the maximum efficiency and wear.

Daniel's Ammonia Packing is used everywhere in the "States" and abroad. Wherever you find refrigerating machinery, you'll find P.P.P.

FREE

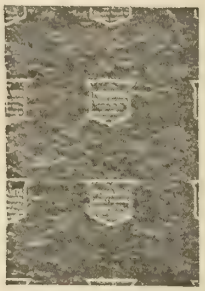
Send us a blue print or sketch of your stuffing-box, and our Ammonia Expert will tell you just how it should be packed.

No charge, and no obligation for this service. It is absolutely FREE.

Quaker City Rubber Co.

PHILADELPHIA, U.S.A.

These Tests Prove J-M Permanite Packing Best For All Conditions



The following tests, which eminent engineers recently made of J-M Permanite Sheet Packing, should be of interest to every engineer:

Oil Test

A sample of J-M Permanite Packing which had been soaked in oil showed no signs of deterioration when tested under a steam pressure of 340 pounds per square inch.

Superheated Steam Test

When tested under steam superheated to 500 degrees Fah., J-M Permanite Packing remained absolutely steam tight and required no following up. The joint was then broken and the packing found in such condition that it was replaced on flange and continued in service.

Saturated Steam Test

A 3-inch main steam joint packed with J-M Permanite Packing remained absolutely tight at 160 pounds per square inch pressure and required no following up. On 90 pounds pressure, carrying steam in the day time only, Permanite held perfectly.

Hydraulic Test

Joints made with J-M Permanite Packing in piping, carrying water at 1,700 pounds per square inch pressure, remained absolutely tight under continuous service.

Pneumatic Test

Piping with joints made of this packing, carrying 100 pounds air pressure per square inch, was subjected to a great deal of vibration and intense heat night and day for a month, and joints were perfectly tight at the end of test.

Do you know of any other packing that will stand such tests?

If there is such a condition in your plant where no other sheet packing will hold, try J-M Permanite and convince yourself that it is the best for every purpose.

Write nearest branch for sample and booklet.

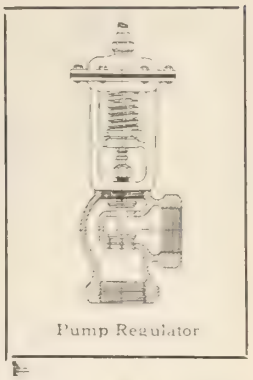
The Canadian H. W. Johns-Manville Co., Limited

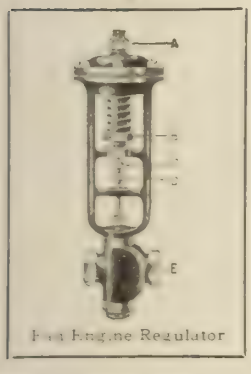
Toronto, Ont. Montreal, Que. Winnipeg, Man. Vancouver, B.C.

1170

Economy Producers

WATTS REGULATORS

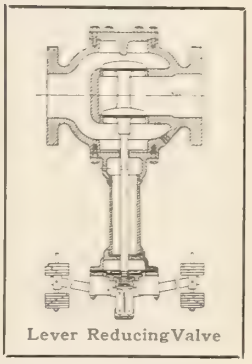

Pump Regulator


Feed Engine Regulator

Canadian Distributors

Power Economies, Limited

9 St. Nicholas Street, Montreal


Lever Reducing Valve

ONCE IN, IT WORKS FOREVER

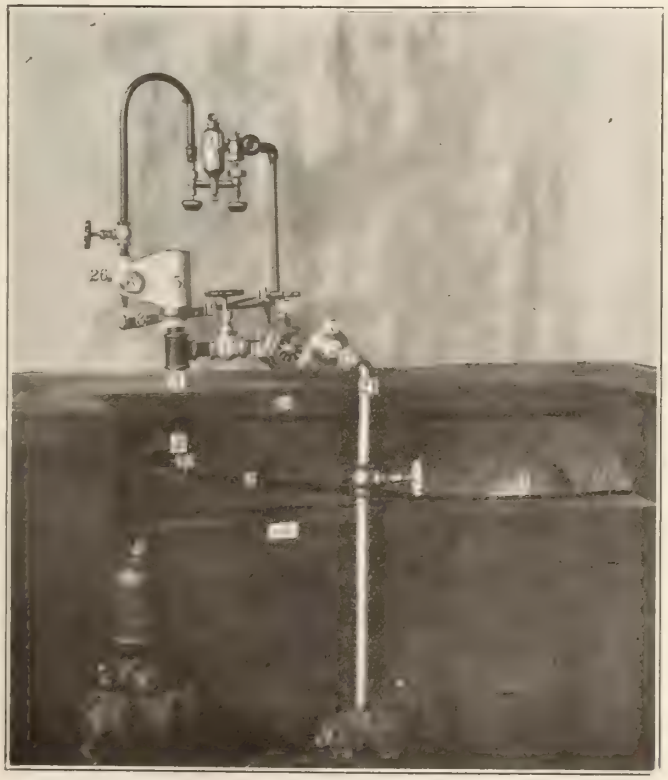
The beauty of installing a Bice Regulator is that you can immediately forget all about the problem of keeping the water in your boiler at the right level.

The Bice Regulator

does it automatically. It regulates one boiler or any number of boilers, maintaining a constant, uniform supply of water in each boiler, under all conditions. It is a self-contained Brass Casting, simple in design, easily attached to any kind of steam boiler, whether used for power or heating purposes. Does away with the pump governor on Single Boilers. Requires no attention whatever. There are more than

Thirty Real Reasons

why every engineer should be acquainted with the Bice Regulator Our free booklet tells all about it and a copy is waiting here for YOU. Write us for it.



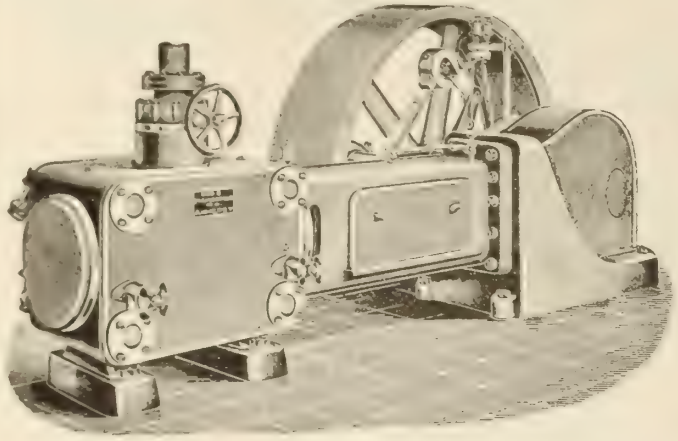
The Bice Regulator Co., Ltd.

2 Green & Swift Bldg. : LONDON, ONT.

Agents for Ontario---The Asbestos & Rubber Goods Co., 141 King Street East, Toronto

Agent for Quebec---E. F. Owen, Room 1008 E. T. Bank Building, Montreal.

Robb Corliss Engines



Have the Armstrong-Corliss valve gear, which will operate at a higher speed than the ordinary releasing gear.

This valve gear does not depend on springs or dash pots for closing, and runs without noise.

The wearing parts of the valve gear are enclosed in a casing and run in oil so that friction is reduced to a minimum.

Robb Engineering Co. LIMITED

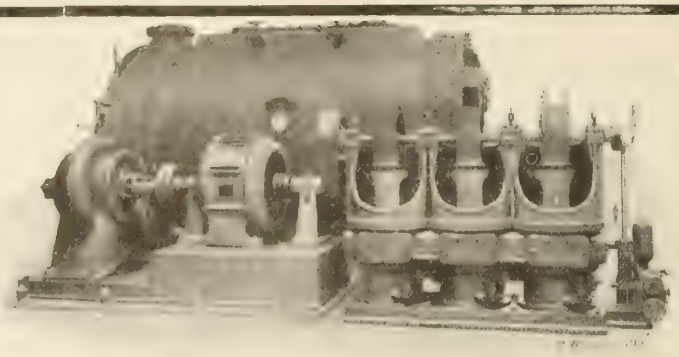
AMHERST, N.S.

DISTRICT OFFICES:

Canadian Express Building, Montreal		R. W. Robb, Manager
Traders Bank Building, Toronto	-	Wm. McKay, "
Union Bank Building, Winnipeg	-	W. F. Porter, "
Grain Exchange Building, Calgary	-	J. F. Porter, "

Highest Vacuum

Special



Best Efficiency

Designs

CONDENSING PLANTS

OF EVERY DESCRIPTION

Barometric Low Level Jet or Surface

All on the Counter-Current Principle

"Edwards" Valveless Air Pumps Dry Air Pumps

The Canadian Boving Co., Ltd., 164 Bay St.

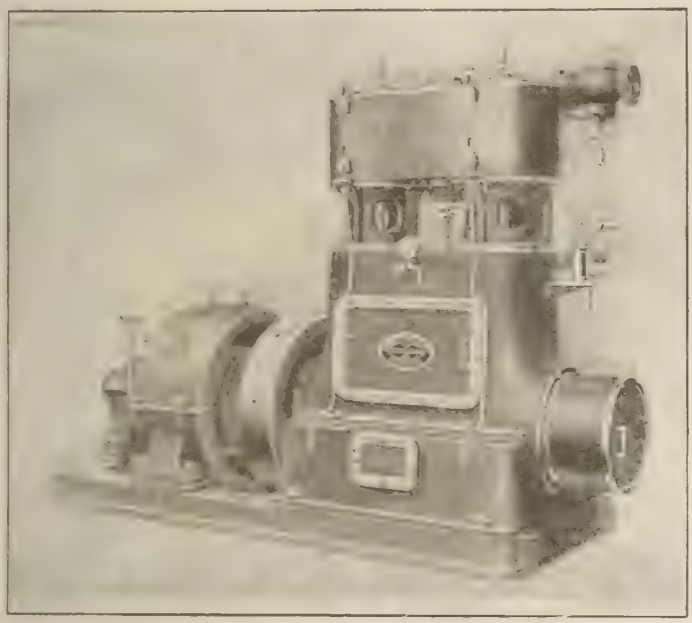
TORONTO

Vancouver Office: 427 Seymour Street. H. W KENT, Local Manager.

The advertiser would like to know where you saw his advertisement—tell him.

"Browett-Lindley"

High Speed, Forced Lubrication, Vertical Engines.



A Few of the Installations within the last few months include:

Two—400 K.W. Engines for the Great Western Railway of Brazil

Two—500 K.W. Engines for the Carlisle Corporation

Four—200 K.W. Engines for the New Floating Dock (British Admiralty)

And fifty (50) others of different sizes, ranging from 25 K.W. up to 500 K.W

FOR SALE BY

E. Leonard & Sons,

London, Ont.

Manufacturers of

High and Slow Speed Engines, High Pressure Boilers, etc., and Complete Steam Plants with Accessories.

Canadian Agents for
"National" Gas Engines and Producers

Warehouses and Agencies at
Montreal, St. John, N.B., Calgary, Winnipeg, Vancouver.

WATER TOWERS

Side view Penstock Distributor built for Ontario Power Co., Niagara Falls

We build and erect ***Penstocks, Water Towers, Heavy Plate Work***

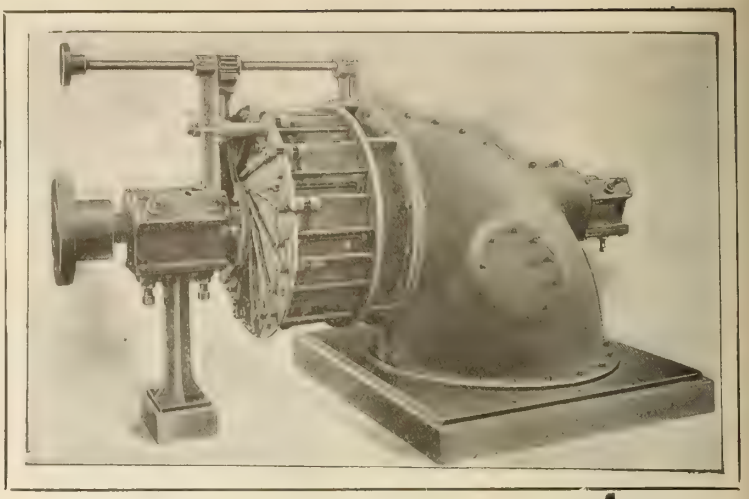
LET US HAVE YOUR ENQUIRIES.

The John Inglis Co., Limited

ENGINEERS AND BOILER MAKERS

14 Strachan Avenue - - Toronto, Canada

Samson Turbines



Are POWERFUL, FAST RUNNING, EFFICIENT and DURABLE.

They can be adapted to all water power requirements.

They can be installed vertically or horizontally, and will work successfully under the most severe conditions.

If you own a water power, or are interested in the development of one, our catalogue will be of service to you. Shall we send it?

William Hamilton Company, Limited

PETERBOROUGH : : ONTARIO

"NULLI SECUNDUS"

JONES STOKER

JONES UNDER-FEED STOKER CO. LIMITED MONTREAL, TORONTO.

THE JONES STOKER produces complete combustion in the furnace, eliminates smoke and produces the greatest possible amount of steam per pound of coal.

JONES UNDERFEED STOKER CO.,
LIMITED

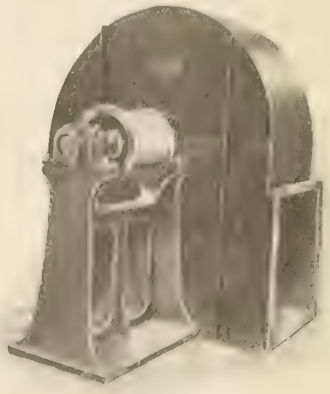
National Trust Bldg. TORONTO — Corristine Bldg. MONTREAL

THE **CYCLONE** HEAVY PATTERN

BELT BLOWER

is designed and constructed to give **A MAXIMUM OUTPUT** when taking **A MINIMUM POWER**, and is of the highest class BRITISH MANUFACTURE suitable for

Induced Draft
Smiths' Fires
Refuse Collection
etc., etc.



Prices Low

ASK OUR AGENTS FOR CATALOGUE No. 128

MATTHEWS & YATES, LTD., SWINTON Manchester, Eng.

AGENTS FOR CANADA
BAIN & MITCHELL, Y.M.C.A. Building, Montreal
ANGLO-AMERICAN SUPPLY CO. Ltd., 311 Enderton, Bldg., Winnipeg

The advertiser would like to know where you saw his advertisement—tell him.

BELLISS
Steam Turbines

For High Pressure or Exhaust Steam or a combination of both.

It is of equally high grade with the Belliss Reciprocating Engine so well known in Canada.

Impulse Type---No small clearances in vicinity of the fixed or moving vanes

The Belliss is the only drum built turbine on the market which cannot strip.

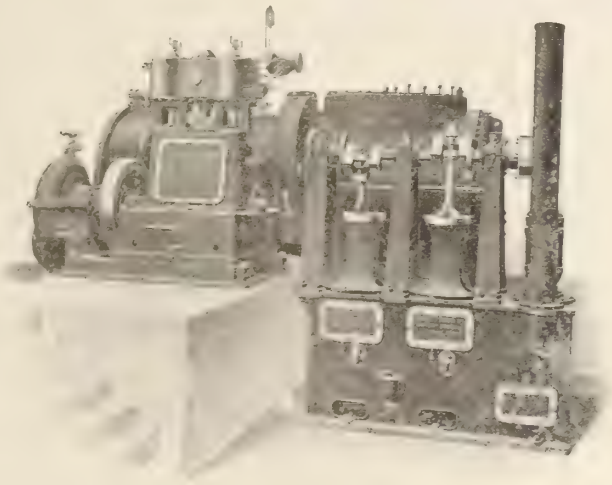
City of Johannesburg (South Africa) have placed a repeat order for a Belliss 3,000 K.W. Turbine. Aston Manor Electricity Works have placed a repeat order for a 2.500 K.W. Turbine.

Many other installations equally satisfactory.

Quotations given for complete plants erected anywhere in Canada, including the

BELLISS
SURFACE
CONDENSING PLANT

or alternative jet type.



Write for Turbine Pamphlet

LAURIE & LAMB

CONSULTING AND CONTRACTING ENGINEERS

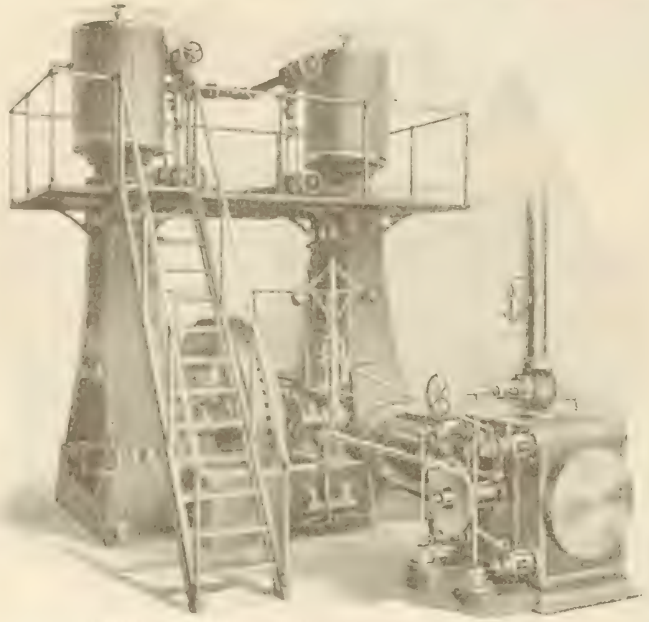
211 Board of Trade Building, - - - - Montreal

Sole Agents for BELLISS & MORCOM Limited, Birmingham, Eng.

Ice Making and Refrigerating Machinery

SUPPLIED AND INSTALLED ON

The York Manufacturing Co. Systems



SINGLE ACTING VERTICAL COMPRESSORS.

For Ice-making Plants, Cold Stores, Abattoirs, Packing Houses, Dairies, Breweries, Hotels, Apartment Houses, etc.

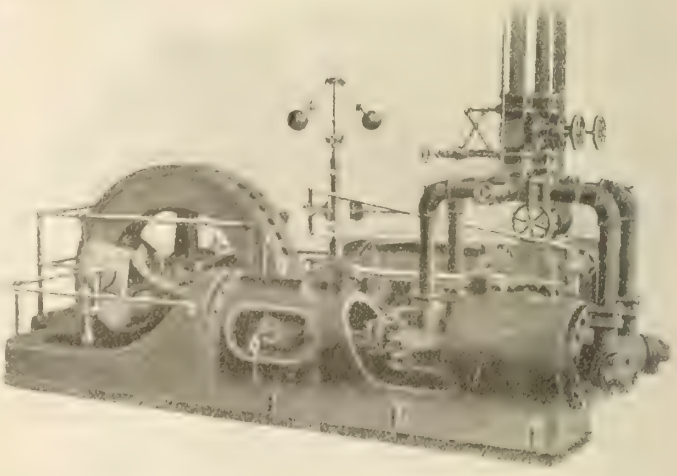
Nonpareil Corkboard Insulation

For Cold Storage Buildings, Packing Houses, Abattoirs, Refrigerators, etc.

List below is where some of our plants are installed:

Manning Cold Storage Co. -	Toronto
Harris Abattoir Co. - -	Toronto
Robertson Bros., Confectioners -	Toronto
Campbell, Griffin Co. -	Calgary, Alta.
T. Eaton Co. -	Toronto and Winnipeg
P. Poulin & Co. - -	Montreal
Guaranteed Pure Milk Co. -	Montreal
Deaf and Dumb Institute -	Montreal

and others.



HORIZONTAL, DOUBLE ACTING COMPRESSOR -STEAM DRIVEN

FURTHER PARTICULARS AND CATALOGUES ON REQUEST.

The Kent Company, Limited

REFRIGERATING ENGINEERS AND CONTRACTORS

MONTREAL, QUE.

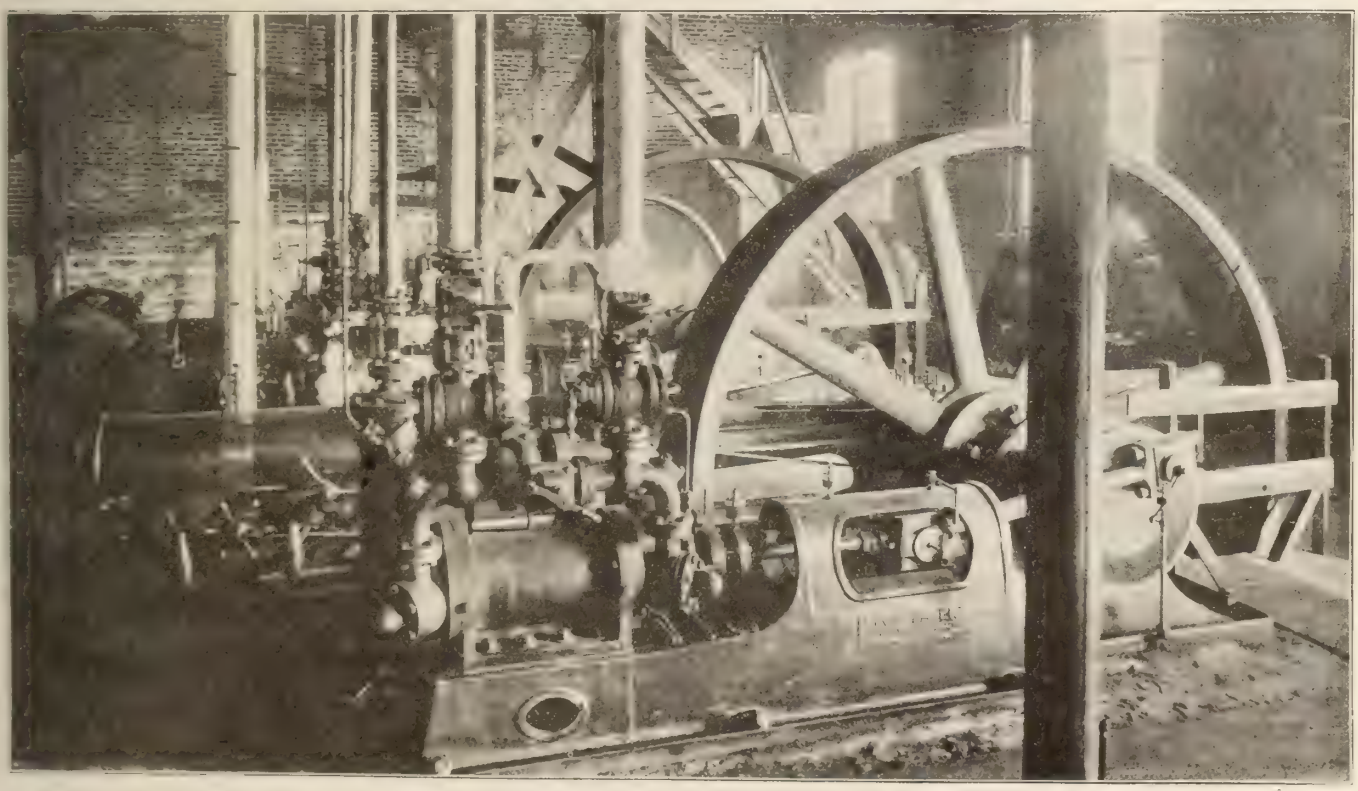
Refrigeration Machinery

For Cold Storage and Ice Making Plants. Manufactured and Installed on

THE LINDE (Ammonia and Carbonic Acids) SYSTEMS

CORKBOARD INSULATION—Nonpareil, Excelsior, Patent Seamless—
Efficiency with Economy

Complete plants designed and installed. These systems have been installed by us in hundreds of the most up-to-date cold storage plants, packing houses, abattoirs, breweries, apartment houses, etc., throughout Canada. Particulars on request.



Write to-day for complete illustrated catalogue, showing details of installations and containing useful tables and data. Sent free on request.

The Linde British Refrigeration Co., Limited
(of Canada)

Montreal, Que.

An Ice Machine Economy

Advantages.

1.—Cooling water problem eliminated. We require only 2½ gallons of water per hour per ton refrigeration per day.

2.—High head pressures avoided in hot weather when water supply is short.

3.—Power required for fan ¼ H.P. per ton refrigeration. No circulating water pump used.

4.—Economy of floor space.

5.—Reduction in amount of Ammonia piping necessary. Elimination of almost all ammonia condenser pipe.

6.—Scaling trouble nil.

7.—Minimum head pressures and minimum liquid ammonia temperature.

8.—Efficiency and low head pressure maintained in hot summer weather

Refrigerating Engineers will be interested in this latest development of a marked advance in Ammonia Condensers.

The G-S Evaporative Ammonia Condenser

has distinctive features that will impress its value on the minds of all users

It is made by the well-known engineering house, THE GRISCOM-SPENCER CO., of New York.

Write us your requirements.

FULL INFORMATION IS AT YOUR DISPOSAL.

H. L. PEILER & CO., 52 St. James Street, MONTREAL
404 McKinnon Bldg., TORONTO

Aqua Ammonia
Anhydrous Ammonia
Calcium Chloride

IF YOU WANT THE

"Best by Test"

Highest Quality at Lowest Prices

Send your Order to Us.

JOHN G. HARVEY, Limited,

PHONE NORTH 3760. TORONTO, CANADA.

The advertiser would like to know where you saw his advertisement—tell him.

The Value of Practical Experience in

Cold Storage and Refrigeration

THIS page is directed to people who are contemplating the erection of Cold Storage and Refrigerating Plants, or the extension of existing plants.

In this particular branch of work, viz.: Refrigeration and Cold Storage, I claim to be an expert.

Many years of practical experience with a large number of successful installations, in many countries, substantiate this claim.

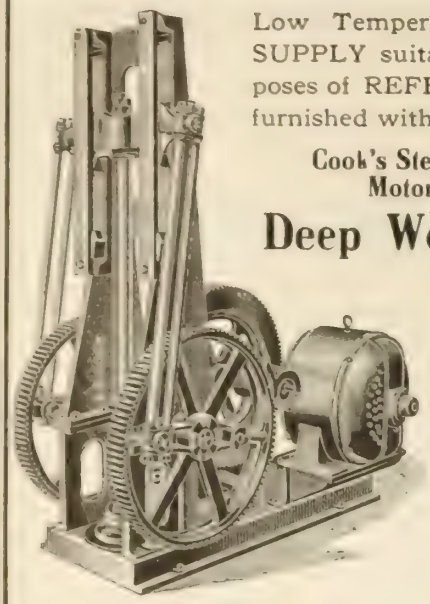
I am not a selling agent for any manufacturer. Neither am I prejudiced for or against any particular system or method of refrigeration. In carrying on the business of Cold Storage Architect and Refrigeration Expert, I am giving my clients the benefit of an extensive experience, and unbiassed expert service.

In soliciting business from you I invite correspondence on any matter connected with refrigeration from the purchase of machinery and supplies to the designing and supervision of a complete modern refrigerating plant.

E. J. GREENSTREET, F.R.A.I.C.

COLD STORAGE ARCHITECT AND REFRIGERATING EXPERT

32 ADELAIDE STREET EAST : TORONTO, ONTARIO



Low Temperature WATER SUPPLY suitable for all purposes of REFRIGERATION is furnished with

Cook's Steam, Belt and Motor Driven

Deep Well Pumps

Cook's Patent Brass

Tube Well Strainer

A Specialty.

Write for Catalogue.

A. D. COOK

MANUFACTURER
Lawrenceburg, Indiana, U.S.A.

CANADIAN CASUALTY AND BOILER INSURANCE CO.

Now owned and controlled by The General Accident, Fire and Life Association of Perth, Scotland.

Assets over $8,000,000.

Full deposit with the Dominion Government.

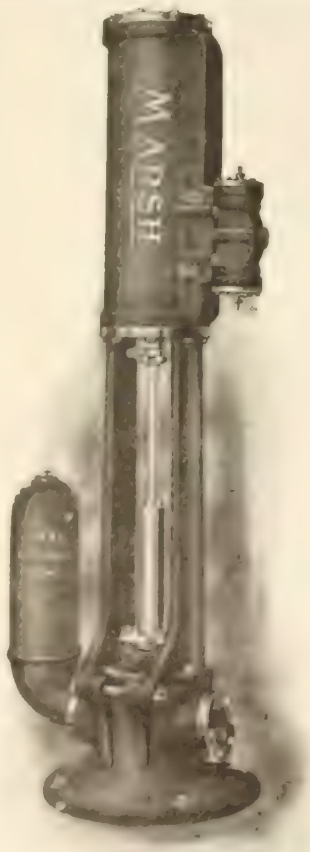
Prompt Settlement our Motto.
Boiler Policies Up-to-date.
Inspections First Class.

Everything of the Best.

A. M. Wickens, Chief Engineer.
C. Norie-Miller, Manager.

CONTINENTAL LIFE BUILDING.

Phone Main 6941.



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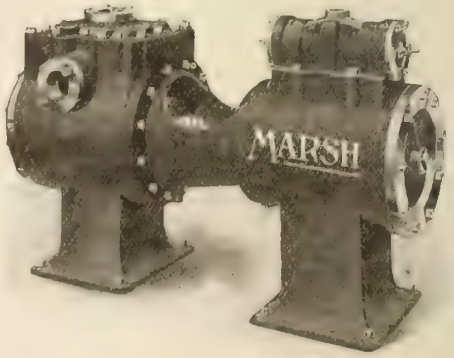

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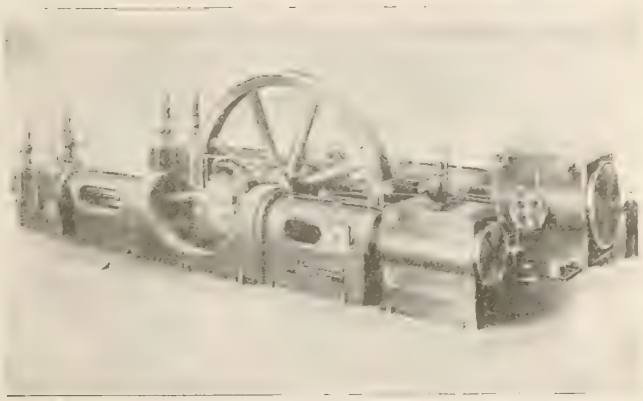

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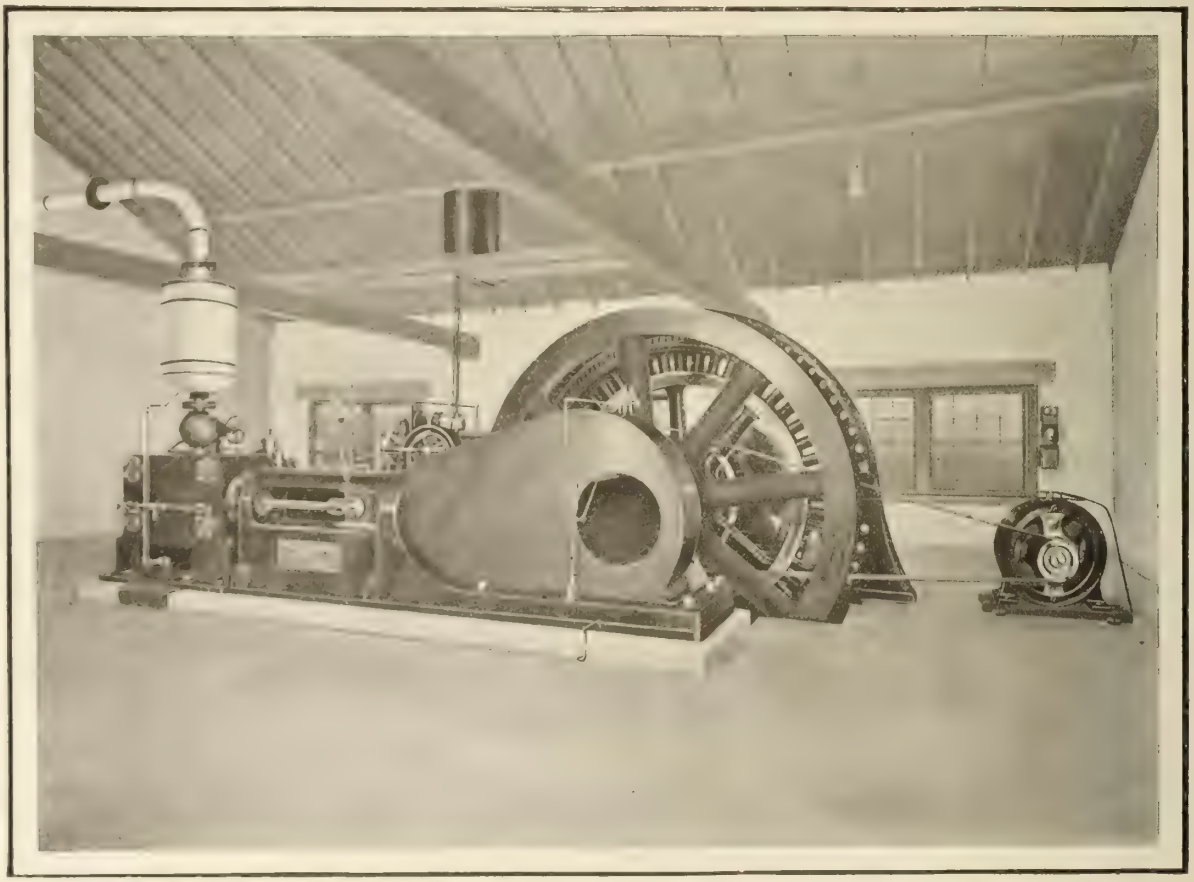

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The Problems of Every Day Refrigeration Practice

By E. J. Greenstreet, F.R.A.I.C. *

Those Interested in Refrigeration or Those Who Become Interested in the Subject, Naturally Wish to Understand How Refrigeration Problems are Solved — For Instance, "What Capacity Plant Shall I Require for My Business?" is a Question Often Asked— The Purpose of This Article is to Present in a Clear, Concise Manner, the Answers to These Common and Re-occurring Problems.

THERE are certain questions that are frequently asked by people interested in cold storage and refrigeration, that many of us are expected to answer, and about which it is well to have some knowledge. The user of refrigeration, say the brewer, packer, produce merchant, butcher, or indeed the dealer in any kind of perishable produce, has a pretty good idea of what he wants. The packer knows for instance that he requires to handle so many hogs per day, and is quite aware that in order to conduct his business successfully, it is necessary to cool them to a given temperature in a given time. He is also aware that the rooms must be kept at certain temperatures. He is not able to figure out however, just how much refrigeration has to be provided in order to do the work; that is a matter about which the engineer is expected to give information. It is well therefore to know the principle upon which the amount of refrigeration necessary in any given case is estimated.

The British Thermal Unit.

It is absolutely necessary to understand first of all the unit by which refrigeration is measured. To do so we must start with the British Thermal Unit, viz., the amount of heat required to increase the temperature of one pound of water one degree Faht. In refrigeration the B.T.U. is the unit of measurement, only in cold storage work we are working conversely. We are taking away or extracting heat units instead of applying them. It might be said that the unit of refrigeration is the amount of cooling that has to be done to reduce the temperature of one pound of water one degree Faht.

In practice, however, and for the sake of convenience 284,000 B.T.U.'s are taken as the unit and called one ton of refrigeration. Before going further let us understand why there should be just 284,000 B.T.U.'s in the ton of refrigeration. That is easily explained. It has been shown that one B.T.U. has to be taken from one pound of water to reduce the temperature one degree F., say from 33 deg. to 32 deg., but to go further and change that pound of water into ice, that is to change its condition from the liquid to the solid, 142 B.T.U. have to be extracted. We have only to multiply 142 by 2000 and we get one ton of refrigeration—284,000 B.T.U.'s. In refrigerating machinery therefore, a ten-ton plant is capable of extracting 2,840,000 B.T.U.'s in 24 hours, or in other words will do the same amount of cooling per day as the melting of ten tons of ice.

Practical Application.

To deal next with the practical application of the above rule, let us take a typical case. Assume for instance that it is necessary to estimate the size of a refrigerating plant to cool 100 hogs per day, of an average weight of 250 lbs. each, from a temperature of say 80 deg. F. to 35 deg. F., that is to reduce the temperature of the meat 45 deg. F. If pork had the same specific heat as water the calculation would be as follows: 100x250x45 equal 1,125,000 B.T.U.'s, or about four tons of refrigeration. The specific heat of meat, at the temperature we are dealing with, is however, less than that of water. It varies somewhat according to different authorities, but it will be sufficiently close for our purpose if we take it to be .75, water being 1. We then get the calculation slightly changed as follows: 100x250x45x.75 equal to 843,750 B.T.U.'s or roughly speaking three tons of refrigeration instead of four tons.

The above calculation gives of course, only the amount of refrigeration required assuming it all to be applied to the work in question, and nothing lost. That however, is impossible in practice. There is loss by radiation through walls, floors and ceilings. The extent of this loss will depend on the quality of the insulation and cannot be determined unless we know the construction of the room and the insulating value of the materials of which it is built. The loss by radiation through the walls of cold storage buildings varies all the way from 1 B.T.U. to 3 or 4 B.T.U.'s per square foot of surface, per degree of difference between the inside and outside temperatures, per 24 hours. For the purpose of calculation, however, we will assume that the insulation will transmit 2 B.T.U.'s per square foot of surface, per degree of difference, per 24 hours. If the room in which the 100 hogs are hanging is for example 20ft. x 20ft. x 10 ft. high, and the inside temperature is 35 deg. F., and the outside temperature 80 degrees F., we can calculate the loss of refrigeration through walls, etc., as follows. There will be in the walls, floor and ceiling of such a room 1600 superficial feet. Therefore 1600x2x45 equals 144,000 B.T.U.'s or rather more than ½ ton of refrigeration per 24 hours. In addition to the above estimate it is necessary to allow a margin for loss from various causes such as imperfect application, opening doors, etc., etc., so it would not be unreasonable to increase our 3½ tons of refrigeration to say 5 tons which would not be far out in actual practice.

Some of the hand books on refrigeration give as an approximate rule, that one ton of refrigeration is required to take care of about 20 hogs of an average weight of 250 lbs. I have given the more detailed calculation, however, in order to indicate the principles upon which such an estimate should be based. The above will show that there are several distinct factors governing the amount of refrigeration required in cold storage work, viz., the amount of produce to be cooled daily; the number of degrees through which it has to be cooled; and the temperature at which the produce has to be kept after cooling.

I have known of cases where attempts have been made to do an impossible amount of work with a plant of a given size, and where failure and loss have resulted, not because the refrigerating machinery was not working properly, but entirely owing to the fact that an excessive amount of work was being thrown on the plant. The managers of some cold storage establishments seem to think that because they have found it comparatively easy to maintain certain temperatures it matters little how much goes into the rooms each day. This of course is wrong, for it has already been shown that the greater portion of the power is frequently required to cool the goods and not to supply the loss by radiation. In cases where goods have to be held for long periods in cold storage and the rooms remain closed the greater portion of the time, the amount of refrigeration required is comparatively slight. Then the loss by radiation through walls, etc., is all that the plant has to take care of.

* Cold storage architect and refrigerator expert, Toronto.

Freezing.

The foregoing examples refer to the amount of refrigeration required where comparatively high temperatures are dealt with. In estimating the amount of refrigeration necessary to freeze meat or other produce, quite another element has to be taken into consideration. That is the latent heat of freezing. We have seen that in the case of water 142 B.T.U.'s have to be taken away from each pound in order to convert it into ice. The same process takes place in freezing meat or anything else, and if the latent heat of the two substances were the same, we would have to extract 142 B.T.U.'s from every pound of meat in order to freeze it, that is assuming it to be already cooled down to the freezing point. The latent heat of freezing in the case of all kinds of produce is somewhat less than that of water, and is approximately in proportion to the amount of moisture in the composition of the article.

Let us now "return to our muttons"—or I should say our hogs—and see what amount of refrigeration would be required, supposing we had to freeze them, and hold after freezing, at a temperature of 15 degrees F. We had 100 hogs of an average weight of 250 lbs. or 25,000 lbs. of pork. We will assume the initial temperature to be the same as before, viz., 80 degrees F. In this case we have to cool the meat down to say 29 deg. F., which is about the freezing point of meats, and not 32 degs. as in the case of fresh water. The calculation therefore would work out as follows: 25,000x51x.75 equal 956,250 B.T.U's. This gives the refrigeration required to cool to the freezing point. Taking the latent heat of freezing for meat at 100, the calculation for the amount of refrigeration required to freeze the meat would be 25,000x100 or 2,500,000 B.T.U.'s. We have still to calculate the refrigeration necessary to reduce the temperature of the frozen meat from 29 deg. (which we took as the freezing point of meat) to 15 deg. F. Now the specific heat of frozen meat is but little more than one-half that of meat above the freezing point, in the same way that the specific heat of ice is approximately one-half that of water. Let us therefore take the specific heat as being .40 instead of .75 as in the case of meat above the freezing point, and we get the following result: 25,000x14 (the difference between 29 and 15 x .40 equal to 140,000 B.T.U.'s.

This gives a total of 3,596,250 B.T.U.'s, or about 13 tons of refrigeration. The foregoing calculations show the difference between merely chilling meat or other produce and hard freezing, and will assist one to realize the vastly greater amount of refrigeration that has to be supplied in cases where hard freezing has to be carried out.

Before leaving the subject of freezing as opposed to chilling a slight digression may be allowed in order to show the mistaken ideas that are sometimes held on this point. I was once called as a witness in a law case where an action for damages was brought against a cold storage company. Hard frozen meat was placed in a cold storage warehouse, the owner stipulating that it should be held at a temperature one or two degrees below freezing point, referring distinctly to the freezing point of water, viz., 32 degrees F. He did not wish the meat stored at the usual temperature for hard frozen meat, which is generally about 15 deg. F. He considered that if kept just under freezing point the beef would come out in better condition. The cold storage company performed their part of the contract and maintained the temperature steadily at about 30 deg. The meat was left in storage for a lengthy period with the result that it came out in poor condition. The evidence showed the freezing point of meat to be about 28 to 29 deg. F., that is several degress below the freezing point of water, and it was proved by a practical, but somewhat costly experiment, that it is impossible to keep meat properly frozen at the temperature demanded in this particular case.

Practical Rules.

I have attempted to show from the above, the principles which govern calculations as to the amount of refrigeration required in various cases. I don't mean to say that the method of calculation indicated is followed as a general rule, but it is certainly of value in enabling one to grasp the broad principles. A knowledge of the subject will be found of great assistance in applying the tables and data for estimating sizes of refrigerating plants, given in the various hand books.

From the foregoing it will be seen that the factors governing the amount of refrigeration required are as follows: The quantity of produce to be cooled in a given time. The number of degrees the produce has to be reduced in temperature, in other words the number of B.T.U.'s that have to be extracted. The loss by radiation through walls, floors and ceilings. This gives the theoretical refrigerating capacity. A very considerable allowance however, must be made for loss in application, for leakage through opening of doors, heat of men working in rooms, etc., etc. These are points impossible to calculate by any given rule. They vary in different cases. Some practical rules however, have been formulated, based on average conditions existing in general refrigeration and cold storage operations. In applying refrigeration to ice making for instance, instead of dealing with water at an initial temperature of say 65 deg. F., and calculating the amount of refrigeration required to convert to ice at say 10 deg. F., an approximation founded on actual experience is generally made. It is frequently assumed in practice that it requires about two tons of refrigeration to produce one ton of ice. Let us see how the theoretical calculation would work out. To reduce the temperature of each pound of water from 65 to 32 degrees requires 33 B.T.U.'s. To change from liquid to the solid requires 142 B.T.U.'s. To reduce the temperature of the frozen water to say 10 deg., requires 12 B.T.U.'s (the specific heat of ice being .55). This gives a total of 187 B.T.U.'s, which multiplied by 2,000 pounds equals 374,000 B.T.U.'s or roughly 1 1-3 tons refrigeration, instead of about two tons which is found necessary in practice. The other 2-3 tons therefore is necessary to make good the unavoidable loss owing to imperfect application, leakage through insulation, etc.

In the case of meat cooling, too, it is frequently taken as a practical rule that 1 ton of refrigeration will take care of 15 hogs. Our calculation of the actual refrigeration gave 3½ tons for 100 hogs. The greater estimate found necessary in practice, is to supply the loss from the causes indicated.

Where rooms have to be maintained at given temperatures and no produce has to be cooled day by day, refrigeration has to be supplied to offset loss through the insulation. In such cases it is obvious that the size and shape of the rooms are very important factors. The larger the size of the warehouse and the nearer to the cube in shape the less refrigeration required. Tables have been compiled giving the amount of refrigeration required in cold stores of varying capacities and with insulation of different values. For instance some authorities assume that to maintain a temperature of 35 deg. in rooms of 10,000 cubic feet capacity under average conditions of insulation, etc., one ton of refrigerating capacity per 24 hours, is required for every 6,000 or 7,000 cubic feet of refrigerated space. In rooms, or buildings of 100,000 cubic feet capacity, the number of cubic feet of space covered by one ton of refrigeration, would of course be greater, probably about double.

In brewery refrigeration rules for approximate estimates have been formulated, based on the ton of refrigeration to so many barrels of beer made per day. Such figures, however, are apt to be misleading, and should not be used except for rough approximate estimates. The amount of refrigeration in brewery work should be calculated for each particular operation, such as cooling water

or brine, cooling wort, dealing with the heat produced by fermentation, cooling cellars, etc., etc.

Rapid Cooling and Pre-cooling.

Sometimes cases occur where it is necessary to freeze or cool rapidly. In freezing fish for instance, the work is generally done as quickly as possible, and in the pre-cooling of fruit in refrigerator cars the temperature has to be reduced in a short time. The refrigerator cars cannot well remain on the tracks a sufficient length of time to enable the cooling to be performed gradually. This brings a new factor into operation in estimating the amount of refrigeration required. The capacity of all refrigerating machinery is based on the work done per 24 hours, and in speaking of a 20-ton refrigerating plant, it means a machine capable of performing that amount of work in 24 hours. If, therefore, a given quantity of produce has to be cooled in a less period that 24 hours, a greater amount of refrigeration has to be provided, corresponding to the reduced time in which the work has to be performed.

For instance, if the work has to be done in 12 hours instead of 24 hours, the size of the plant, for all practical purpose, has to be doubled. This principle is well exemplified in the cooling of fruits, and accounts for the enormous plants that have recently been erected in California for the pre-cooling of oranges, etc.

A pre-cooling plant has recently been erected at Roseville, Cal., the refrigerating machinery in connection with same having an ice-making capacity of 250 tons per day, that is a refrigerating capacity of 500 tons per 24 hours. This large plant is used for cooling Californian fruits, and vegetables, previous to transportation to the eastern markets. The cooling, or pre-cooling as it is generally called, is done directly in the refrigerator cars. A number of cars are cooled at the same time, the plant having a capacity of dealing with 24 cars simultaneously. The temperature of cars and contents can be reduced from outside atmospheric temperature to about 40 degs. in two or three hours' time. Some interesting problems in refrigeration were solved in carrying out these pre-cooling operations. To reduce the temperature of the fruit packed as it is in a refrigeration car, and to apply the necessary refrigeration in such a manner that the cooling is carried out rapidly is not by any means an easy matter. Not only is it necessary to remove the specific heat of the fruit, vegetables, etc., but also the emanations given off by fruit at high temperatures. In the plant I have referred to this is accomplished by means of an air blast from the pre-cooling station.

Description of System.

The system is known as the "Intermittent Vacuum Process." The operation being as follows: Air ducts are attached to the openings in the top of the ordinary refrigerator car and connected with a fan in the pre-cooling house, which exhausts from the car. A discharge duct from the pre-cooling house is attached to the centre doorway of the car, and by means of a fan cold air is forced into the car at that point. This arrangement enables a current of cold air to be forced through the car in much the same way that refrigeration is applied in some cold storage houses. The method in which it is operated, however, is somewhat different. At intervals the cold air discharging into the car is shut off, the exhaust alone being worked. This, of course, produces a partial vacuum in the car. Such vacuum, it is claimed, causes the fruit to part with its heat and also its gases more readily. During the brief period during which the cold air is shut off, and air is being withdrawn from the car, the exhaust discharges into the atmosphere, thus getting rid of the heat and emanations. This exhausting process is only continued at short intervals, and then the circulation of cold air through the car is resumed.

APRIL POWER TRANSMISSION NUMBER.

If you or your friends are interested in "Power Transmission" of any form, we are recommending in advance that no obstacle interfere with your or their certainty of securing a copy of the April issue of "The Power House."

The results obtained with this plant are reported to have been very successful. Car loads of California Tokay grapes have been sent from California to Philadelphia, New York, and Chicago. They arrived in splendid condition, and brought from fifteen to twenty cents per case more than non-precooled shipments. In the case of tender vegetables the loss in shipping to distant markets was said to be twenty to thirty per cent. without pre-cooling. With shipments properly pre-cooled there was practically no loss. Another advantage claimed for pre-cooling is the saving in the quantity of ice required to cool the car and contents during transit.

This extremely rapid cooling has some disadvantages. It is difficult to do the work as thoroughly as it is in cases where a longer time is allowed for the removal of the heat and gases. There is also a tendency to use lower temperatures than should be employed with the consequent danger of damage to certain kinds of fruits. This disadvantage is probably not so marked in the case of oranges and circus fruits, as the skin and outer coating protects the fruit to some extent and prevents the ill-effects of too low temperatures. This question of pre-cooling is undoubtedly a very important one, and should be of exceptional interest to the fruit growers of Ontario, as enabling them to extend the radius within which they are able to market their fruits. It is not to be undertaken lightly however, and the system of pre-cooling requires very careful consideration. There are certainly cases where the better plan would be to cool the fruit previous to transit, in properly constructed plants located as near the orchards as possible. There is no doubt the work can be done more thoroughly by taking a longer time and doing the cooling more gradually than is possible in a refrigerator car.

There is one other point that should be kept in mind when considering pre-cooling plants for adoption in Canada, and that is that plants such as have been erected in California necessitate an enormous reserve of refrigerating power in order to perform the work quickly. That means a large outlay in the way of first cost, as well as the plant remaining idle for a considerable portion of the year.

Application of Refrigeration.

The foregoing remarks deal principally with the power of refrigerating plants for various purposes, and touch on some of the points that have to be considered in estimating the amount of refrigeration that has to be provided in certain cases. Nothing has been said as to the various methods of applying the refrigeration to the work in question. The three systems of application are pretty well known and I will only refer to them briefly. The "Direct Expansion System" consists in placing the pipes containing the expanding ammonia directly in the rooms to be cooled. In the indirect method, known as "Brine Circulation" a non-congealable fluid is first cooled to the required temperature, and then circulated through pipes placed in rooms. The method known as "Air Circulation" consists in cooling air by passing it over brine pipes or expansion pipes nested in a small chamber called the air cooler and then circulating the air through the rooms to be cooled by means of fans and ducts.

There is probably no greater difference of opinion amongst cold storage men, on any subject, than upon this question of application. Some cold storage warehouses are fitted with one system, and some with another, and much has been said upon the merits and de-merits of each.

To deal fully with this subject and go into the advantages and disadvantages of these three systems would take too long, and I would certainly exceed my allotted space. I can only generalize and say that before deciding which system to install, quite a number of factors have to be taken into consideration. Unfortunately the first cost of installation is frequently the governing factor, and the cheapest method is often adopted regardless of whether it is the most suitable for the particular work in question.

As a matter of fact a decision on this important point should only be reached after a careful consideration of the kinds of produce to be handled, the temperatures to be maintained, the conditions under which the work is to be performed, and the manner in which the cold storage warehouse is to be operated. Hard frozen produce stored at very low temperatures, where a variation of a few degrees makes but little difference, is one thing, and the storage of delicate produce such as eggs, which require a steady temperature with but slight variation, is quite another matter. The question of moisture, the degree of humidity in the rooms, and the necessity for ventilation, are all matters that have to be taken into account in deciding which method of application to adopt. It is possible to go even further, and point out that there is a vast difference in the manner in which any one system is applied. Air circulation for instance, may be arranged to give either good or bad results, and the same remark applies to an installation on either the "Direct Expansion" or "Brine Circulation" systems.

Enough has probably been said to show that refrigeration as applied to the various commercial undertakings is a somewhat complex subject. To obtain the most successful result, and in order to install a plant to give the greatest economy in working, combined with efficiency, there are many varying factors to be taken into account.

All I have attempted to do is to call attention to some of these matters in order that refrigeration may not be too lightly undertaken, and in the hope that careful consideration may be given to each individual case of cold storage work. Only a little thought and consideration of the subject is needed to avoid some of the failures of the past, and in order to apply refrigeration successfully to the numerous industries requiring these systems.

GRAVITY BRINE SYSTEM INSTALLED IN PETERBORO.

The William Scott Co., Peterboro, Ont., have installed a Gravity Brine System of refrigeration. The plant was formerly an overhead direct-ice cooling system. A large egg room on the main floor was fitted up with an ice room directly above it. In the basement were located brick vats for egg pickling and this space was cooled to a moderately low temperature by direct conduction from the egg room above. As originally equipped the space refrigerated did not embrace the entire floor area, but only four out of the six sections or bents of the building, or what would be two-thirds of the total space.

In rebuilding from the overhead ice system installed, in what was originally a grain elevator, some changes were necessary, but the remodelling was not of an expensive character nor was the cost of fitting up and reinsulating as large as anticipated.

The "Gravity Brine" system was installed by the Madison, Cooper Co., Watertown, N.Y., under the approval of the Cold Storage Division of the Department of Agriculture and the William Scott Co. secured the 30 per cent. subsidy granted by the Dominion Government to builders of approved cold storage plants.

Fig. 1 shows a transverse section of the building and Fig. 2 a longitudinal section. It will be noted that the coil rooms are entirely outside the refrigerated space and do not therefore reduce the available storage space on the first and second floor.

The tanks rest on the fourth floor where also is located the fan for ventilating, air heater, air washer, etc., in connection with the ventilating system. Also located on this floor is the electric motor, which in addition to operating the ventilating system, power ice crusher and endless chain bucket ice elevator, is used for operating the freight elevator, or "lift."

In transverse section the tower, which is a part of the endless chain bucket elevator, may be seen, as other parts of the apparatus. In operation ice is fed to the ice crusher through a chute, and after being crushed, drops into the endless chain bucket elevator, which raises it to the top of the tower from which it slides by gravity through the inclined spout to the primary tanks. The inclined ice spout terminates in a flexible spout which may be bent and turned to

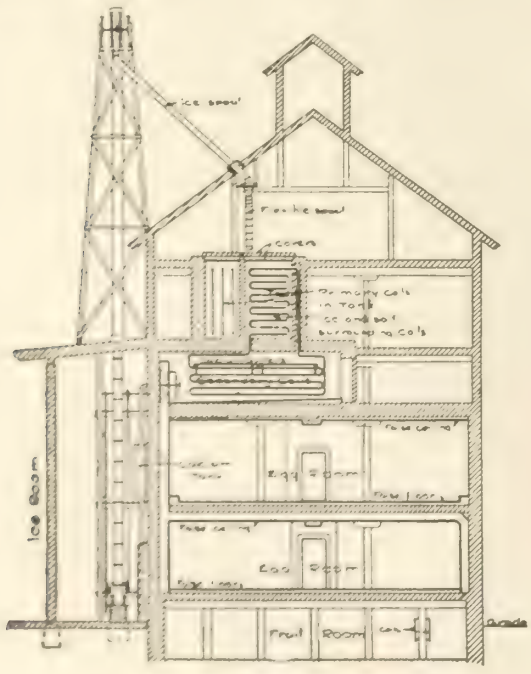


Fig. 1.---Transverse Section.

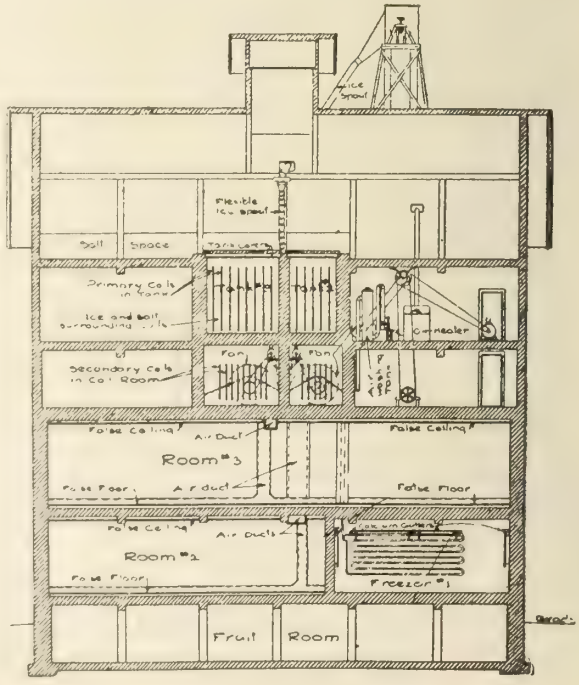


Fig. 2.---Longitudinal Section.

deliver ice to any one of the primary tanks. A car icing spout is also attached so that crushed ice may be delivered to the side of the building for icing cars on sidetrack. This makes it possible to do the work of icing the tanks and cars with very little manual labor.

The primary means of cooling in this plant is by natural ice. The secondary coils of the Gravity Brine System in the coil rooms which cool egg rooms, and in the freezers and the drip coils in basement fruit room, are all equipped with the Chloride of Calcium Process for preventing frost on cooling pipes and purifying and drying the air of the storage room. The ventilating system is for furnishing pure, dry and cool air at any season of the year. In addition a heater is installed for the heating of the rooms if necessary in very cold weather or for drying whitewash when the periodical yearly whitewashing occurs.

GASKETS FOR AMMONIA JOINTS.

Gaskets and jointing material for piping, etc., are the subject of much diversity of opinion among operating engineers.

Much depends, we believe, on the judgment displayed in the choice of the material for a particular purpose and on the exercise of like good judgment in its application. The conditions under which different plants operate call for an individual treatment peculiar to each and this should be kept in view by the man responsible.

Lead or rubber is the debatable issue encountered in this field. The objection urged against lead gaskets is that they cannot be used again if the joint is broken. This, I think is true of most jointing materials if sufficient care is not taken to protect and save them. Lead joints are known to the writer as having lasted several years during which time breaking of the joint was often necessary for purposes outwith itself.

Rubber gaskets again are open to the vulcanizing objection which while admitted to a lesser or greater extent does not preclude their large and satisfactory use in many plants.

Whichever type of joint is used, corrugated lead or rubber, care should be taken that it is slightly smaller than the circle inside the bolt bodies, otherwise you have no provision for taking up the increased diameter of gasket due to the tightening up of the bolts.

Painting the gaskets, whether lead or rubber is a necessary adjunct to satisfactory results. The personal element in the making of a joint is of equal importance to that of the material, consequently a skilled exponent should be requisitioned to do the job.

To do almost anything well, requires exercise of hand and head in combination with material, and joints subject to exacting conditions afford ample opportunity for the triple display.—A.E.B.

Series of Practical Questions and Answers for Engineers

By A. E. B.

Every Care is Being Taken to Include Only Pertinent Practical Questions, and Give Same, Direct Reliable Answers. Catch Questions will be Avoided. The Knowledge of Simple Addition, Subtraction, Multiplication and Division of Decimals, Will be Found a Most Useful Companion Study, and Should Not be Overlooked.

43.—Q. Superheated steam is being largely adopted in steam engine and steam turbine practice. Indicate briefly, why?

A. To minimise the losses of efficiency and economy which are unaviodable to a lesser or greater extent from condensation in the steam pipe between boiler and engine, and in the engine cylinder by the expansive use of the steam there. What goes to make the proposition attractive, is the fact that the superheat required does not involve extra fuel cost, the otherwise waste heat being utilized in its attainment.

44—Q. With a high degree of superheat, what precautions are necessary?

A. Careful design and constructional detail of the stop valves and steam piping between the superheater and the engine; of the piston and valve of the first cylinder into which the superheated steam enters and an efficient reliable system of cylinder lubrication.

45—Q. What are the two systems employed to superheat saturated steam?

A. The first and most common arrangement consists in placing the superheater in the flue space of the boiler to abstract the necessary heat from the hot gases. The second arrangement depends on a separate furnace for imparting the superheat.

46—Q. To what strains are the piston and connecting rods of a steam engine subjected?

A. When the piston is moving toward the shaft, they are each under a compressive strain and on the return stroke they are subject to a tensile strain. The compressive strain is the more severe, hence the practice of increasing the connecting rod diameter at the middle of its length or of tapering it from inner to outer end.

47—Q. What is meant by the expression "capacity" as applied to pumps and pumping engines?

A. By "capacity" is implied the quantity of water delivered in a given time. It is expressed as thousand gallons per hour or million gallons per 24 hours, according to size of unit.

48—Q. Explain how you would calculate the horse power necessary to raise 1000 imperial gallons through a total lift of 75 feet?

A. The first requirement would be to reduce 1000 imperial gallons to pounds. This is arrived at by multiplying 1000 by 10, there being 10 pounds of water in an imperial gallon. The result, 10,000 pounds multiplied by 75 feet lift shows that 750,000 foot lbs. power are necessary. As 33,000 foot pounds equal 1 horse power, 750,000 divided by 33,000 will give 22.72 horse power required. Pump efficiency is generally low however, amounting to 50 per cent. or thereabouts, and therefore necessitates provision being made in excess of the above amount, which is theoretical. If the efficiency is say 50 per cent., we arrive at the proper horse power by multiplying 22.72 by 100 and dividing by 50. Thus

$$\frac{22.72 \times 100}{50} = 45.44 \text{ Horse Power.}$$

49—Q. What is understood by the expression "duty" as applied to a steam pumping engine?

A. By "duty" is meant the fuel economy or work accomplished on a given expenditure of heat. It is a recognized standard of performance and like the 33,000 foot pounds per minute, horse power standard, originated with and was established by Watt.

50—Q. How is the "duty" of steam pumping engines determined?

A. Three methods have been used and are given in detail as follows:—

First.—From the number of pounds of water lifted one foot high by the consumption of 100 pounds of coal.

Second.—From the number of pounds of water lifted one foot high by the consumption of 1,000 lbs. of steam. This latter unit is the equivalent of 100 pounds of coal, each pound of which is reckoned as evaporating 10 pounds of water into steam.

Third.—From the number of pounds of water lifted one foot high by the consumption of 1,000,000 heat units; this latter being the equivalent of 100 pounds of coal, each pound of which will impart 10,000 heat units to the water in the boiler, or whose evaporation from and at 212 degrees Fah. is 10,355 pounds of water per pound fuel.

The third method is that now generally adopted.

The work done in foot pounds is expressed as the area of the pump plunger (corrected for area of pump rod), multiplied by the gross pressure against which the pump is working (measured by pressure gauge on the rising main plus the pressure due to height of gauge above surface of water in well), multiplied by average length of stroke of plunger in feet and multiplied again by the total number of single strokes the pump plunger makes during the trial.

The total number of heat units consumed is found by multiplying the aggregate weight of feed water supply to the boiler or boilers by the total heat of the steam at the working pressure, reckoned from the feed water temperature as a basis and making any necessary corrections for moisture or superheat.

51—Q. What constitutes the total heating surface of a return tubular boiler set in brickwork, and what would it amount to in a boiler 72 inches diameter, 18 ft. long, tubed with seventy 4-inch diameter tubes?

A. The lower half of the boiler shell throughout its length and the surface of all the tubes constitute what is known as the total heating surface in this type boiler.

The shell heating surface amounts to one-half the shell circumference in feet multiplied by its total length also in feet. Thus 72 inches, which is 6 feet will have for half circumference

$$\frac{6 \times 3.1416}{2} = 9.4248 \text{ feet.}$$

9.4248 × 18 feet length of shell will give 169.64 square feet or quantity of shell heating surface required.

The tube heating surface is the circumference of the external diameter of one tube in feet multiplied by the length of tube also in feet and again multiplied by the total number of tubes.

The circumference of one 4-inch tube in feet is found thus

$$\frac{4 \times 3.1416}{12} = 1.0472 \text{ feet.}$$

We divide by 12 because the multiplication of the two upper quantities gives result in inches.

$1.0472 \times 18 \times 70 = 1319.47$ square feet tube surface.

$1319.47 + 169.64 = 1489.11$ square feet total heating surface of boiler.

52—Q. On what principles does a refrigerating machine operate?

A. You compress by means of external force a gas or vapour and extract its heat to diminish its volume. By causing the compressed gas or vapour to expand, you lower its temperature. Heat is again absorbed by the gas or vapour and the latter resumes its original condition, constituting the refrigerating effect of the arrangement.

53—Q. On what does the efficiency of a refrigerating machine depend?

A. The efficiency depends on the difference between extremes of temperature.

54—Q. On what does the useful effect of a refrigerating machine depend?

A. It depends upon the ratio between the heat units eliminated and the work expended in compressing and expanding. This result is independent of the nature of the body employed.

55—Q. We hear a great deal about static electricity and dynamic electricity, give a brief definition of both.

A. Static electricity is that produced by friction; dynamic electricity that produced by a dynamo and known as current electricity.

56—Q. What is the volt?

A. The volt is the practical unit of electro-motive force and represents power or pressure.

57—Q. What is the ampere?

A. The ampere is the practical unit of electric current and is of volume such as is produced by the pressure of one volt blowing through a conductor against a resistance of one ohm.

Explanation of Principles Involved in Answers to Questions

By Pedestal

The Bolstering up of Oneself With the Memorizing of a Series of "Don'ts," With Bald Knowledge Given of What You Should do, and the Cramming of Your Head With "Kinks," Will be of Little Service in Enabling You to "Hold Down" a Position, if You Have Neglected to Add Intelligence to Your Knowledge. Many a Child Can Repeat the Alphabet, but Cannot Distinguish One Letter From Another. In This Series we Aim to Help You.

EXHAUST LEAD AND LAP.

Question 44 in our February issue asked for a definition of exhaust lead and lap. Supplementary to the answer then given, figures 12 and 13 are here shown. In the first case Fig. 12, end A, the exhaust edge of the slide valve and inner edge of steam port are cupping, that is neither exhaust lead or lap is apparent with the valve in its middle position on the cylinder valve face.

In the second case same figure, end K, the exhaust edge of the slide valve is seen to overlap the inner edge of the steam port. The amount of this overlap is known as exhaust lap with the valve in its middle position on the cylinder valve face.

In the third case figure 13, end V, the exhaust edge of the slide valve does not reach to the inner edge of the steam port. The amount by which it fails, with the valve in its middle position on the cylinder valve face, is known as exhaust lead.

End F, same figure, shows exhaust lap same as end K, figure 12.

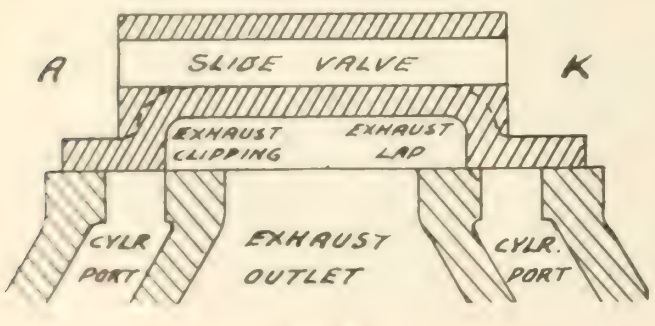


Fig 12.

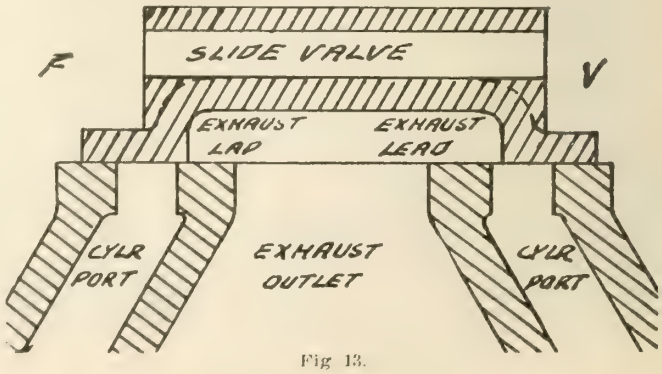


Fig 13.

ELECTRICITY IN MECHANICAL LANGUAGE.

To facilitate the acquirement of a general electrical knowledge by operating engineers, a method involving the adoption of analogies between steam or water and the electric current has found much favor. A study of electricity along these lines enables a clearer and quicker grasp to be got of the principles involved, without in any way endangering the quality of result aimed at.

The mechanical and operating engineer is accustomed to deal with elements which flow and circulate through pipes and similar devices, and if he finds that in the study of the electric current he can use these as aids, it does not necessarily follow that they be incorporated in his electrical equipment as realities.

The accompanying sketch Fig. 14 shows by analogy with a water pumping equipment, a continuous current series system of arc lighting. A centrifugal pump piped from its discharge outlet to an installation of water motors with return to its suction, forms the basis on which it is hoped to display an easy and intelligent means of acquiring the electrical idea.

The starting up of the pump, with its chamber and the piping full of water, causes a continuous circulation throughout the system on an energy expenditure of amount corresponding to the friction of, or resistance to the flow of water.

This friction of water in pipes as is well known has to be provided for in pump installations generally.

Thus far we have carried the analogy to the point where the pump may be called the dynamo, the piping the cable or wire, the friction or resistance to water flow, that of the resistance offered by an electrical conductor.

The introduction of a number of water motors on the line of flow, to be impelled by it, means additional energy expenditure on the part of the pump whose capability in circulating the water will determine their efficiency.

Introducing the analogy again, our water motors correspond to the arc lamps in an arc lighting installation; an almost similar effect being there readily noted.

From the continuous circulation of the water through a single pipe line on which is placed the various water motors, we have as a result a continuous current dynamo operating on a single circuit with a series distribution of lamps, and known as already stated as the continuous current series system of arc lighting. It finds application in docks, warehouses and kindred outfits.

THE PRINCIPLE OF THE ARC LAMP

It seems appropriate to briefly describe the principle of operation of the arc lamp as a sequel to the description of the nature of its current supply.

The arc lamp is an apparatus so arranged that two carbon or graphite rods are held and controlled end to end. The passing of an electric current through them when in contact produces a light, which when that contact is broken and a slight space intervenes, becomes more intense and shows a flame.

This flame known as an electrical arc will remain steady while the rod points maintain the proper distance apart. The idea aimed at in all arc lamps is to maintain this proper distance apart as a constant quantity.

The carbon or graphite rods of course are slowly consumed and require periodical renewal; that from which the current flows burning faster than the other.

Current Direction in the Arc

The direction in which the light is thrown depends upon the position of the carbon points. The positive or that from which the current flows becomes hollowed out, while the negative becomes pointed. The upper carbon if positive, projects the arc downward while the lower carbon if positive projects the arc upward.

For ordinary lighting, the positive wire from the machine should always be connected to the terminal of the lamp communicating with the upper carbon.

Carbons should be of diameter to suit the current and the upper carbon longer than the lower to provide for its burning away faster than the latter.

Hissing of the arc is due to excess of current for the size of carbons or the separation of the points being insufficient.

HYDRAULIC MEMORMANDA.

1 Imperial gallon contains 277 cubic inches of fresh water.

1 Imperial gallon contains 10 pounds of fresh water.

1 U.S. gallon contains 231 cubic inches of fresh water.

1 U.S. gallon contains 8.33 pounds of fresh water.

1 cubic foot of fresh water at 62 degrees, Fah., weighs 62.55 pounds.

1 cubic foot of fresh water at 62 degrees, F., contains 7.48 U.S. gallons.

1 cubic foot of fresh water at 62 degrees, Fah., contains 6.23 Imperial gallons.

Water is at its greatest density at 39.2 degrees Fah., at which 1 cubic foot weighs 62,425 pounds.

2.31 feet depth of fresh water at 62 degrees Fah., will produce a pressure of one pound per sq. inch.

Height of column of water divided by 2.31 will give pressure in pounds per sq. inch.

Pressure in pounds per sq. inch, due to a column of water multiplied by 2.31 will give the head in feet.

One Imperial gallon of fresh water raised 1 foot high equals 10 foot pounds, therefore 100 Imperial gallons raised 50 feet high equals $10 \times 100 \times 50$, equals 50,000 foot pounds.

One U.S. gallon of fresh water raised 1 foot high equals 8.33 foot pounds, therefore 100 U.S. gallons raised 50 feet high equals $8.33 \times 100 \times 50$, equals 41,650 foot pounds.

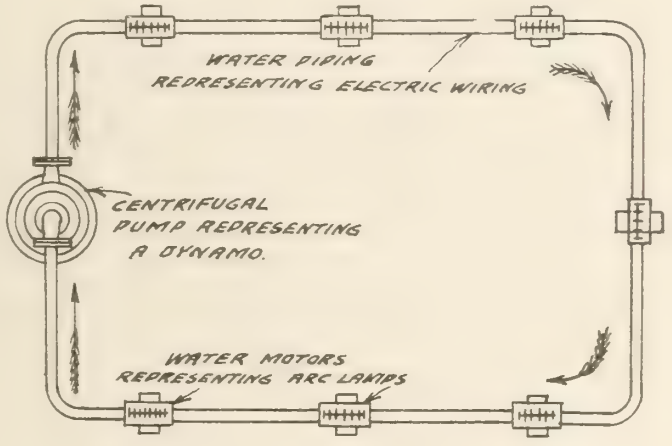
The British thermal unit, (B.T.U.) or Joule's equivalent of heat is 772 foot pounds, and represents the energy necessary to raise one pound of water 1 degree Fah. when at or near its point of greatest density, 39.2 degrees Fah.

One horse power equals 33,000 foot pounds per minute.

One horse power

$$\frac{33{,}000}{772} \text{ equals } 42.74 \text{ B.T.U. per min.}$$

One horse power equals 746 watts.
One kilowatt equals 1.34 horse power.
One kilowatt equals 1,000 watts.



GAYLEY DRY BLAST INSTALLATION.

By K. Campbell.

THE Hamilton Steel Co., of Canada, Hamilton, recently installed a Gayley dry blast system for supplying dry air to the blast furnace. A total of 60,000 cubic feet free air per minute is used for the blast furnaces, and if the humidity is high a large amount of extra coke is required to eliminate the moisture from the furnace.

With the Gayley dry blast system, the blast furaace air is forced through large nests of coils, in which cold brine is circulating, and practically all the moisture remains adhering to coils in the form of ice. The result is that the blast furnace is supplied with air which is practically dry, and a large saving in coke is made.

Air Circulation.

Atmospheric air enters the building at each end, passing over two nests of coils, in which brine at 32 degrees Fah. is circulated. This precipitates a greater part of the moisture in the form of dew or rain, these coils in consequence being known as rain coils. The air is then circulated through five nests of coils, in which brine at 5 degrees Fah. is circulated, the remaining moisture adhering to the pipes in the form of ice, these coils in consequence being known as ice coils.

The air now being thoroughly dried passes to the blowing engine through two large air ducts and thence to the two blast furnaces.

When the accumulation of ice on the ice coils becomes so great as to interfere with the free circulation of air, the coils are cut out in rotation and thawed off by sprinkling with warm water taken from the overflow of the ammonia condenser. They are then cut in again and the brine put in circulation in these coils, as before.

Brine Circulation.

The brine is circulated by means of three cross-compound crank and flywheel pumps, supplied by the Canada Foundry Co., Toronto. This company also supplied a large duplex auxiliary pump for the same purpose.

The brine on leaving the pumps passes through four cylindrical shell brine coolers, made by the Isbell Porter Co., of Newark, N.J. In these coolers are 10,000 sq. feet cooling surface. The brine passing through coils of pipe in the interior of the shell cooler, is cooled by contact with liquid ammonia in the state of rapid evaporation. The cool brine then passes into the refrigeration building and through the rain and ice coils, returning to the pumps to be recirculated through the brine coolers.

Ammonia Circulation.

Refrigeration is effected by three large horizontal, double-acting ammonia compressors. These machines compress the ammonia gas $N.H_3$ to a pressure of approximately 150 lbs. per sq. in. The gas is then discharged to the ammonia condensers, where it is passed through long coils of 2 in. piping, through which water circulates in 1¼ in. piping, the system being known as the double pipe condenser system. As a result of extracting the heat in the condensers, the compressed $N.H_3$ gas liquefies and is then ready for re-expansion in the brine coolers, from which it returns to the ammonia compressors and the cycle of operations is re-commenced.

Machinery Equipment.

The three refrigerating machines were supplied by the De La Vergne Machine Co., New York. These are of the twin cross-compound type. There are two water-jacketed horizontal, double-acting compressors, 18 in. diam. by 33 in. stroke.

The 26 condensers are so arranged that they may be used independently or together. There are 6,270 sq. ft. of effective cooling surface, cooling 1,908 U. S. gallons of brine per minute from 17 deg. F. to 7 deg. F. The six receivers are each 15 in. by 6 ft. horizontal pattern.

The system at the Hamilton plant of the Steel Co. of Canada, is in charge of J. L. Campbell, to whom the writer is indebted for the information. The plant was designed by the Frank Roberts Co., of Philadelphia.

F. W. NIEBLING'S CATALOGUE.

The F. W. Neibling Co., Highland avenue, Norwood, Cincinnati, Ohio, have issued a 128 page, 6x9 ins. catalogue of Ice and Refrigerating Machinery. In addition to descriptive matter on their large variety of machines and fittings, valuable information is given on such subjects as plate ice making, erecting, charging and testing of plant, daily log and report, tables of bolts and studs, operating costs, cold storage temperatures and other valuable tables. The F. W. Neibling Co. installed an 80-ton machine in the plant of the Vancouver Ice and Cold Storage Co., and are now getting out a 130-ton machine for this company. As soon as the machine is completed it will be described in The Power House.

CAN ICE-MAKING PLANTS.

By Douglas G. Keith.

In an artificial ice making system it is necessary in order to produce transparent ice, to remove the air and impurities from the water to be frozen. There are two methods of doing this —First by agitating the water during the freezing process, which ice is known to the trade as raw water ice, and second, by thoroughly distilling and purifying the water before freezing.

There are a number of systems in use in which the first method is employed, the most common being known as the plate system, in which freezing plates made of pipe coils or hollow cells are immersed in a tank filled with fresh filtered water. The cooling medium, either ammonia or cold brine, is circulated through the plates, causing the water to freeze on the sides of the plates.

After the ice is frozen to the required thickness it is thawed loose from the plates by circulating warm ammonia or brine. The cake of ice is then lifted from the tank and cut into the proper size blocks, or the ice may be cut into the required size blocks in the tank by steam or electric cutters. In this process the water is agitated by injecting air into the water near the bottom of the tank.

Another system, using the same method, is to place cans filled with fresh water in cold brine and inject a jet of air into the can to keep the water in agitation. This system produces a very good quality of ice, if the water is free from impurities. With some waters, however, it is necessary, when the block is nearly frozen, to pump out the core which contains the impurities and refill with fresh water, while with others it is necessary to purify the water before putting in the cans.

Another system is to make the cans large enough so that the ice can be cut through the centre or divided into the desired number of pieces (usually four), these divisions being made so that the resultant blocks will have practically the same structure as plate ice, that is, it will be frozen from the one side. This makes it possible to remove, when necessary, the impurities contained in the centre or core of the original block, the centre of the block may be pumped out and refilled with fresh water and frozen solid, or it may be left unfrozen if desired. In this system the water, being frozen, is agitated by air or by circulation.

Distilling Water.

The second method is the one in which the water to be frozen is distilled, that is, the steam is condensed, and the resultant water is frozen in cans or moulds of any desired size or shape by immersing the cans or moulds to within a few inches of their top in a tank containing a solution of chloride of sodium or calcium brine. The brine is kept at temperature sufficiently below the freezing point of water to freeze the water in the desired time.

There are a number of methods used

for cooling the brine. The one most commonly used is to evaporate ammonia in a series of pipe coils placed between the cans, these coils being called the "Expansion Coils." Other methods which are sometimes used to cool the brine are designed to meet special conditions, and usually consist of cooling it in separate tanks or coolers, or in separate sections of the freezing tank itself. The brine in all cases should be agitated so as to keep the temperature as nearly even throughout the tank as possible.

Weight of Cake of Ice	Inside Dimensions				Thickness of Material U. S. Standard Gauge	
	Top	Bottom	Length	Length Over All	Sides	Bottom
50 Lbs.	8 x 8	7½ x 7½	31	32	No. 16	No. 16
100 "	8 x 16	7¼ x 15¼	31	32	No. 16	No. 16
200 "	11½ x 22½	10½ x 21½	31	32	No. 16	No. 16
300 "	11½ x 22½	10½ x 21½	44	45	No. 16	No. 16
400 "	11½ x 22½	10½ x 21½	57	58	No. 14	No. 14

After the water is frozen in the cans or moulds they are lifted from the tank by a suitable hoist and conveyed to the thawing or dumping platform where the cans are dipped into, or sprinkled with warm water, thus thawing the ice loose from the sides and bottom of can, and allowing its removal. After the ice is taken out, the cans are refilled with water and replaced in the tank.

The accompanying table gives the standard sizes of cans adopted by the Ice Machine Builders' Association.

TONNAGE CAPACITY OF COMPRESSORS.

By Cold.

WHAT shall constitute the unit of refrigeration as applied to actual operating capacity of the refrigerating compressor, and how this is to be accurately determined is a subject discussed in a recent publication of the Triumph Ice Machine Co., Cincinnati. The Ice Machine Builders' Association has searched for some unit that would enable customers to specifically designate their requirements before the different manufacturers from whom they intended to solicit quotations and data. The various builders of refrigerating machinery have been placed at a great disadvantage in the past in bidding on specifications which stipulated the tonnage of compressor required, without stipulating the conditions under which such compressors were to operate. This omission would enable those manufacturers who give their compressors high ratings and high speeds, to place their machines on the same capacity basis as those compressors which are conservatively rated.

While up to the present time no definite unit has been adopted, it is conceded that the refrigerating capacity of a compressor depends upon the number of pounds of gas it will handle in a given unit of time. The weight of ammonia gas handled depends upon the efficiency of the compressor and particularly upon the suction pressure, or the pressure at which the gas is delivered into the compressor.

The density of ammonia gas varies approximately as the absolute pressure, therefore the refrigerating capacity of a given compressor varies directly with the absolute suction pressure; a compressor working under a suction pressure of thirty pounds, will have approximately 50 per cent. greater capacity than one working under fifteen pound gauge pressure.

To determine the net amount of refrigeration resulting from evaporating one pound of liquid ammonia at a given back pressure, it is necessary to deduct from the latent heat of evaporation at that pressure, the energy expended to cool the ammonia itself from the temperature at which it enters the evaporating coils to the temperature at which evaporation occurs.

The temperature at which the ammonia enters the evaporating coils should be but very little higher than that of the water flowing away from the ammonia condenser.

In the accompanying table is shown the number of cubic feet of gas which must be pumped per minute at different suction and condensing pressures to produce one ton of refrigeration per twenty-four hours. The values given are theoretical and it is assumed that the temperature of the ammonia entering the evaporating coils corresponds to the temperatures of condensation and the pressures given, and consequently no allowance is made for unavoidable losses. These unavoidable losses, however, make it necessary to add about 20 per cent. to the theoretical values to determine the customary commercial rating of a compressor. It is therefore evident that the net refrigerating effect of a compressor must depend,

First, upon the suction pressure.

Second, upon the temperature at which the ammonia enters the refrigerating coils.

In determining the commercial capacity of each given compressor of a stated cylinder size and at a constant speed, the exact conditions under which such a compressor is to operate must be known. This, however, is frequently a difficult matter to find out, and the customary duty of a compressor is divided into three distinct classes which will represent the various duties encountered, viz.:

1. Brewery refrigeration, or those cold storage institutions in which temperatures of from 25 to 35 degrees Fahr. are maintained.

2. Ice manufacturing or where temperatures of from 10 to 20 degrees Fahr are to be carried.

3. Fish, poultry or butter freezers or other cold stores to be kept at temperatures of from zero to 10 degrees above zero.

Temperature of Gas in Degrees F.	Corresponding Suction Pressure Pounds per Square Inch	Temperature of the Gas in Degrees F. 65°	70°	75°	80°	85°	90°	95°	100°	105°
		Corresponding Condenser Pressure (gauge), Pounds per Square Inch. 103	115	127	139	153	168	184	200	218
	G. Pres									
—27°	1	7.22	7.3	7.37	7.46	7.54	7.62	7.70	7.79	7.88
—20°	4	5.84	5.9	5.96	6.03	6.09	6.16	6.23	6.30	6.43
—15°	6	5.35	5.4	5.46	5.52	5.58	5.64	5.70	5.77	5.83
—10°	9	4.66	4.73	4.76	4.81	4.86	4.91	4.97	5.05	5.08
— 5°	13	4 09	4.12	4.17	4.21	4.25	4.30	4.35	4.40	4.44
0°	16	3.59	3.63	3.66	3.70	3.74	3.78	3.83	3.87	3.91
5°	20	3.20	3.24	3.27	3.30	3.34	3.38	3.41	3.45	3.49
10°	24	2.87	2.9	2.93	2.96	2.99	3.02	3.06	3.09	3.12
15°	28	2.59	2.61	2.65	2.68	2.71	2.73	2.76	2.80	2.82
20°	33	2.31	2.34	2.36	2.38	2.41	2.44	2.46	2.49	2.51
25°	39	2.06	2.08	2.10	2.12	2.15	2.17	2.20	2.22	2.24
30°	45	1.85	1.87	1.89	1.91	1.93	1.95	1.97	2.00	2.01
35°	51	1.70	1.72	1.74	1 76	1.77	1.79	1.81	1.83	1.85

Table giving number of cubic feet of gas that must be pumped per minute at different condenser and suction pressures to produce one ton of refrigeration in 24 hours.

DOMESTIC REFRIGERATION.

By A. L. R.

THOUGH to the ordinary householder his yearly contract for his supply of ice is a matter of small moment, it is a decided attraction to the prospectus of an apartment house when it states each tenant will be supplied with a mechanically operated ice box, and a great advertisement of the modern up-to-date hotel is the statement that only pure artificial ice is used.

Thus, though many portions of his daily supply of food may have passed through the wholesale cold storage, yet it is in his own immediate needs that the value of artificial refrigeration is brought home to the consumer. To eliminate the non-sanitary blocks of ice in the refrigerator or drinking water is one of the vital necessities of the modern commissary. When the stored food comes out of a sanitary, clean, germ free receptacle where the never varying temperature has maintained the original fresh condition of the article, the housekeeper appreciates the latest improvement rendered possible by the co-operation of the apartment house.

In hotels the refrigeration service is less obtrusive, though the ice-cold faucet in the bathroom is a direct evidence of the presence somewhere in the hotel of a refrigeration plant.

Both are apparently matters of equal arrangement yet the layout of an apartment house differs materially from that of a hotel. In both cases the question of the refrigerant introduced into the living quarters has to be considered, and consequently one of a harmless kind must be used. Brine previously cooled and circulated through cooling pipes is employed, so should a leakage occur it occasions no annoyance to those occupying the same room where the refrigerator box is installed.

Linton Apartments.

Taking as example one of the modern apartment houses in Montreal, in which a refrigerating plant is installed, the plant in the Linton Apartments on Sherbrooke street shows a satisfactory solution of the ice box problem.

There are 66 suites of rooms situated on 10 floors. Each sink is provided with one ice chest of a capacity of about 10 cubic feet. The refrigerator consists of a solidly constructed well insulated box of approved design containing movable shelves designed for the varying needs of family food supply. At the back of the box are 36 galvanized 1¼ in. pipes arranged in zig-zag coil form. All these boxes are situated directly above one another in the same relative position for the various floors. Altogether the 66 boxes are divided into eight sys-

The brine cooled in the brine refrigerator is forced to a pump of sufficient capacity direct to the top storey through well insulated galvanized piping, where it is diverted into the heads of the pipes serving the various systems. Then by gravitation it circulates through each box on that line. The needs of each box are regulated by a valve. Then the brine after leaving the supply pipe and circulating through the unit box returns heated through the delivery pipe to the brine refrigerator, where it is again cooled before returning to the circulation system. The brine refrigerator is operated by a Linde machine of 20 tons refrigerating capacity. The compressor is 8½x15 operated by a 12x12 in. Wheelock steam engine. To prevent any possible annoyance from the slight vibration of the running machine the foundation proper is super-imposed over a thick layer of pure compressed cork.

MECHANICAL REFRIGERATION.

By Tungsten.

AMONG the various refrigerating mediums, ammonia is perhaps most generally adopted, and among the various systems employed with which to secure its refrigerating effects, those of compression and absorption monopolize the field

Ammonia is favored because of its high latent heat of vaporization, its low vapour tension, and its property of liquefaction at low pressures, and high temperatures. Where ammonia fumes would be objectionable as on board ship, carbonic acid, sulphur dioxide and compressed air are the refrigerating mediums used.

Anhydrous ammonia will remain liquid under atmospheric pressure at 30 degrees below zero Fah., or under 115 pounds gauge pressure at 70 degrees Fah.

Ammonia Compression System.

The compression system is favored and therefore most generally employed, because it can be operated under more varied conditions and is from two to three times more efficient than that of the absorption system. The ordinary working pressures of both systems are from 15 pounds on the evaporating side to 220 pounds on the condensing side.

Fig. 1 represents in a simple yet effective manner the cycle of operations in an ammonia compression system of refrigeration.

Keeping in view the principles underlying the end to be attained, the ammonia gas is first compressed and then relieved of its heat so as to diminish its volume. It is afterwards allowed to expand by doing mechanical work, in process of which its temperature falls. The fall in temperature below that of its contact or surroundings, results in reabsorption of heat and return to initial starting conditions, completing the cycle.

Irrespective of the refrigerative medium used or the machine employed, compression, condensation and expansion are necessary accessories to a successful consummation of the result.

A law of physics declares that all gases when passing from the liquid to the gaseous state absorb more or less heat which is emitted again on reversing the process.

Compression Accessory.

The compressor cylinder is water jacketed as in the case of air compressors, in order to keep the cylinder walls cool.

The downward stroke of the piston draws the ammonia gas into the cylinder through the valve M opening inward and discharges it under compression on the upward stroke through the valve P opening outward. These valves

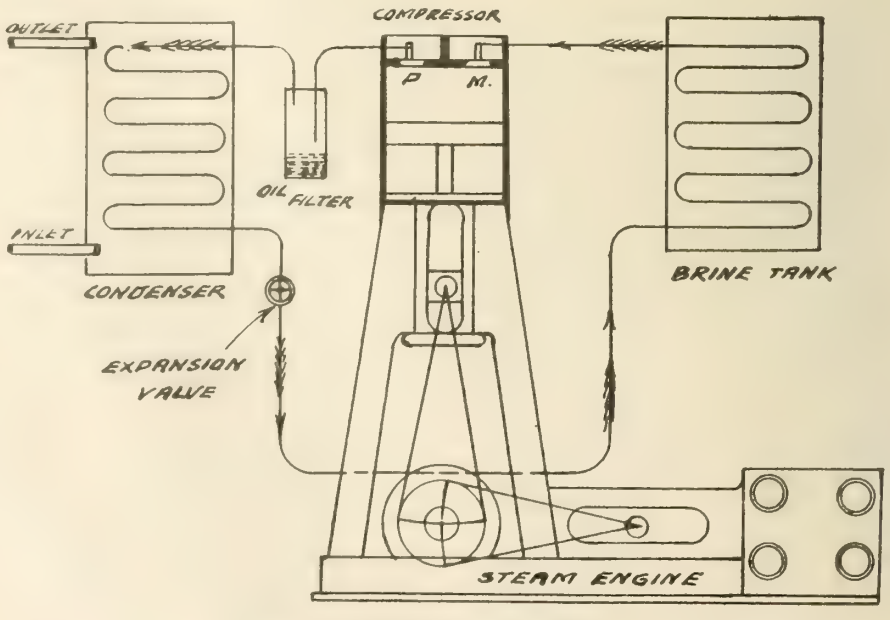


Fig. 1.—Ammonia Compression System.

are held on their seats by spring attachments which determine the particular suction and discharge pressures to be attained by the piston before opening takes place.

These suction and discharge pressures already stated as being from 15 pounds on the former and up to 220 pounds on the latter, are dependent on the medium used and to some extent on the temperature of the condensing water.

Condensation Accessory.

On leaving the compressor, the gas on the point of liquefaction is discharged into the oil separator, from which it passes into the condenser. This latter consists of several coils of pipe over which the water of condensation is sprayed. The gas in passing through the pipe coils gives up its heat to the condensing water and becomes liquefied.

Expansion Accessory.

An expansion valve situated between the pipe coil outlet of the condenser and the brine tank in which a series of expansion coils are placed, permits the liquefied gas being relieved of its excess pressure. The amount of pressure retained varies with the medium used but is, generally speaking, from 10 to 30 pounds above the surrounding atmosphere for ammonia.

Return of the medium to gaseous form is the result of this pressure relief, in process of which heat is extracted from the brine surrounding the expansion coils.

The amount of heat extracted from the latter corresponds to that given up to the condensing water.

Repetition of the whole foregoing operation constitutes the compression system of refrigeration.

Systems and Application.

The brine tank referred to and containing the expansion coils is one of two systems by which the useful effects of refrigeration are applied. From it as a centre the cooled brine is circulated to all points requiring to be cooled.

The other system, known as that of direct expansion, requires the ammonia or other medium to be taken direct to the point to be heated and there evaporated in pipes or other suitable chambers in contact with the object itself.

A diversity of opinion exists as to the superiority, if any, of these two systems over each other. It may be stated that both are largely adopted, and that each performs certain classes of duty effectively.

To ensure the highest efficiency of the apparatus, care should be taken to have valves, pistons, and joints perfectly tight. Attention to this prevents loss of ammonia through leakage and entrance of air. When the brine system is used, the brine should be about 6 degrees cooler than the space intended to be heated.

An Economical G.-S. Evaporative Ammonia Condenser

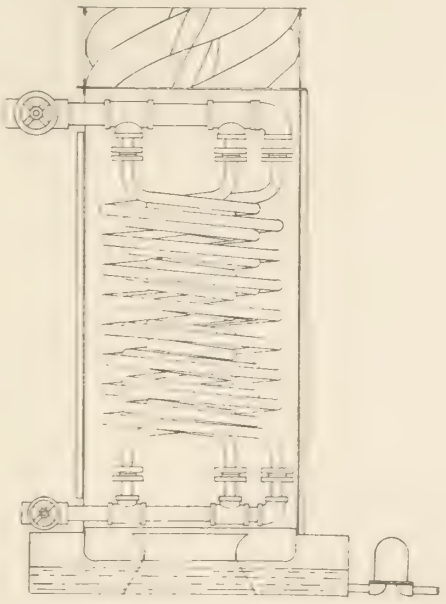
By Service

A Condenser That Uses 2½ Gallons of Water per Hour for Every Ton of Refrigeration Per Day, Has Been Placed on the Market—Necessarily to Obtain This Economy, Some Departures From the Ordinary Design, the Details of Which are Included in This Article.

A NEW evaporative ammonia condenser for refrigerating and ice making plants installed where condensing water is not plentiful or where it is not cool enough to keep the head pressure down to an economical operating basis, has been placed on the market. The principle adopted is to use the heat of vaporization of cooling water fed to the condenser. A guarantee is made that under all ordinary operating conditions, not more than 2½ gallons of water per hour for every ton of refrigeration per day, is required.

This question of water is even more important to the refrigerating engineer than it is to the steam engineer. Lack of sufficient cooling water has a severe and detrimental effect on the economy of the ammonia compressors.

Referring to ammonia tables it is evident that 75 degs. F. compounds to a pressure of 100 square inches, 85 degs. compounds to 168 lbs., 95 degs. compounds to 198 lbs. The power required at the compressors goes up practically as the head pressures. The head pressure depends directly on the temperature maintained at the ammonia condenser. These temperatures depend upon the inlet water temperature of the water furnished in the ordinary ammonia condenser. The summer is the time of maximum load and is also the period of the hottest flood water. The compressors, besides having to run at speeds in proportion to the output required are also subjected to the very severe conditions impressed on them by insufficient cooling water at the ammonia condenser.



G.S. Evaporative Ammonia Condenser.

The operation of the C.-G. condenser is as follows: Series of properly proportioned ammonia coils are arranged inside of the vertical cylindrical shell. The ammonia gas enters at the top manifold, passes down through the coils in parallel, condenses and is drawn off from the bottom manifold. The bottom of the cylindrical shell projects into a circular pan partly filled with water. The water level is maintained by an adjustable float feed at a distance slightly below the bottom edge of the shell. A fan sucks air upward through this shell. As the air passes under the bottom edge of the shell it picks water off the surface over which it passes; this action is largely intensified by a series of stationary baffles giving the air a swirling motion. The result is to rain large quantities of water over the ammonia coils keeping the surface efficiently and completely covered with moisture. Above the top manifold is a series of deflector plates which baffles all the excess water out of the exit air. The air as it comes out is at a low temperature, but its humidity is definitely increased over that of the entering air at the bottom. This increase in humidity means so many pounds of water vaporized in the air passage.

Assuming the severest weather conditions probable, it is claimed that this apparatus is designed so that the fan will handle sufficient air to accomplish the vaporization of the water in sufficient quantities to be an exact measure of the quantity of heat to be abstracted from the condensed ammonia. The old principle of the Oyah or porous water bottle used in Mexico is reproduced. The

exit air in summer time is frequently at a lower temperature than the inlet air, and yet causes sufficient vaporization (not mechanically carried water) to do the cooling required.

The temperature maintained in the body of this machine in the most severe summer weather should not exceed 75 degs. F., and this temperature is arrived at but few days in the year. Below 70 degs. is the usual average, and in winter time the condenser will do very much better than this, as it is designed for hot weather conditions. If an engineer divides his water by 25, he will also divide his scale by 25.

This condenser was designed and manufactured by the Griscom-Spencer Co., New York, whose representatives in Canada are H. L. Peiler & Co., 52 St. James St., Montreal.

COMPACT ICE WATER PLANT.

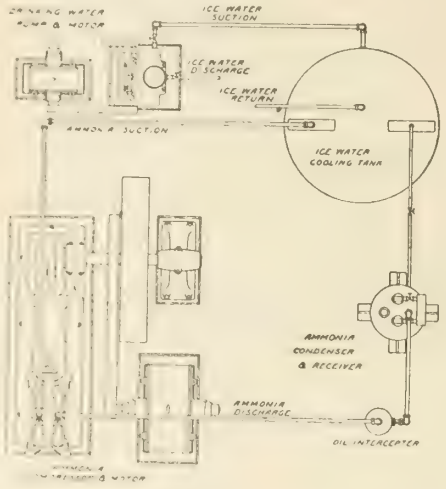
One branch of the refrigerating industry is the ice water system for hotels, offices, bank buildings, etc. In the accompanying illustration is shown an ice water plant. They are small and compact, a 50 gal. per hr. plant requiring 8x10 ft. and a 1½ ton refrigeration plant, while a 400 gal. per hr. plant requires 20x22 ft. and a 14 ton refrigeration plant.

The refrigerating machine for such plants may be operated by whichever power is most convenient. The ammonia, after compression in the refrigerating machine, passes through the oil interceptor where all surplus oil is trapped. The ammonia is next received into the condenser where it is condensed to a liquid, and then deposited in the liquid receiver. From here, it is expanded in coils located in the water cooling tank.

In expanding at an extremely low temperature, the ammonia absorbs the heat of the water, thereby reducing the temperature of the water. This completes the circuit; after serving its purpose in the water compartment, the ammonia is drawn back into the compressor to repeat the above service.

In arranging the ice water piping, it is advisable to provide the supply to the drinking faucets from the up-riser, through which the water is conveyed by means of either a triplex, centrifugal or steam driven pump.

There is a balancing tank (usually in the attic) into which all surplus water



Plan View of Compact Ice Water Plant.

is emptied, and by means of suitable overflow connections, the cold water returns to the main ice water compartment in the basement.

In ice water plants operating but a few hours each day, there is frequently a sufficient quantity of ice formed on the refrigerating coils to maintain the required temperature for a number of hours.

RECENT INSTALLATIONS MADE BY KENT CO., MONTREAL.

The Kent Co., Montreal, with offices in the Canadian Express Bldg., are Canadian representatives of the Armstrong Cork Co., Pittsburg, Pa., manufacturers of corkboard for insulation of cold storage plants, and of the York Mfg. Co., York, Pa., manufacturers of refrigerating and ice-making machinery, including engines, air compressors, boilers, tanks, condensers, coolers, receivers, condensing apparatus, etc. Recent installations made by the Kent Co., include the systems at the Royal Victoria Hospital, Montreal; Guaranteed Pure Milk Co., Montreal; Campbell & Griffiths, Calgary, Alta,; Richmond Dairy and Produce Co., Vancouver; Harris Abattoir, Toronto; T. Eaton Co., Winnipeg; Congregation de Notre Dame, Montreal; P. Poulin, Montreal, and Manning Cold Storage Co., Toronto.

B. C. REFRIGERATING INSTALLATIONS.

The Canadian Fishing Co., Vancouver, B.C., are having installed what will probably be the largest fish freezing plant in Canada. The machinery is being installed by the Triumph Ice Machine Co., Cincinnati. The plant consists of four 42 ton refrigerating machines and an immense amount of pipe. Another installation recently made by this company is the ice cream and dairy plant of the City Dairy Co., Vancouver. An office has been opened by the Triumph Ice Machine Co., in Vancouver, in charge of Ben M. Kirker.

Power Plant Troubles, Happenings and Improvements

By Blackrock

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

THE STEAM TURBINE.

After many years of persistent application and patient research on the part of a few engineers of keen perception and vision, there has been evolved and developed a motive power unit, to wit, "The Steam Turbine," which bids fair to rival the "Reciprocating Steam Engine" in some fields and usurp its place in others. Further, its suitable adaptation makes it a valuable adjunct to a reciprocating engine equipment, in that a combination unit admits of a highly increased power output without material additional operating cost.

Parson's "Turbinia" which the writer had the pleasure of visiting on the Tyne some 14 years ago, was looked upon then, and for some considerable time after by engineers generally, as a forlorn hope.

It is with us to-day however, and very much in evidence as a factor not to be ignored where questions of power equipment for economy and efficiency are concerned.

A feeling of unrest and dissatisfaction with their present power plant installations has laid hold on manufacturers as the result of the advent of this revolutionizer. Tall stories of what is capable of accomplishment by wholly turbine equipped plants or by the addition of exhaust turbine units as utilizers of unconsumed energy presently going to waste from reciprocating engines, tend to this condition of affairs.

These stories gleaned from various quarters; hearsay, newspaper, and tech-

nical journals, show results to be attained more or less general and do not particularize sufficiently to warrant a blind rush in order to be in fashion at any cost.

To the operating engineer, as well as to the man higher up, comes the danger of a too superficial knowledge of the subject.

A series of articles of which the foregoing is introductory will be continued monthly in "The Power House," and will treat of the design, principles, constructional details, application, installation, operation, efficiency and economy of the various classes of steam turbine.

STEAM TURBINE TROUBLES.

The predominant feature and all-absorbing topic in the world of motive power engineering to-day is the steam turbine and its wonderful outlook, if one might judge from the more or less interesting statements that find their way into the pages of technical and trade journals.

Trouble Department.

The trouble department is conspicuous by its absence in most of the "write-up" matter pertaining to this latest engineering development, leading one to infer that although in the earlier years its progress towards becoming a powerful public utility was marked by numerous mishaps, their complete elimination is now a fait accompli.

All achievement worthy the name is accomplished at much trouble and great expense, yet withal in no sense ever perfect. The steam turbine, with us to-day, is a tribute to man's inventive and progressively perfecting genius, and it may be truly said is portentous of immense possibilities, whose attainment can only come through trouble and breakdown experiences.

It has to be realized then that the steam turbine has troubles existent and ahead for designers, constructors, owners and operators. Little is heard of them, however, for obvious reasons. We don't expect those interested to advertise them, and a leakage in the cordon of those-in-the-know is what we have to depend upon for information from behind the scenes.

It is safe to say then that most steam turbine manufacturers have had and are having experiences the reverse of gratifying in many instances.

Vane or Blade Troubles.

Blade troubles are as we would naturally expect predominant; their myriad use, fine clearance and temperature variation being more or less contributory causes.

Blade clearance has been and is a prolific source of trouble. Theoretically the best economy should be obtainable by an almost entire absence of clearance between rotor blade tips and the casing, and between the casing blade tips and the rotor.

Outside of this blade trouble the steam turbine compares more than favorably with the reciprocating engine in the matter of liability to breakdown.

Against this, however, sight must not be lost of the fact that the latter is practically speaking an open book, visible to and giving audible warning of approaching trouble, and accessible therefore for ways and means of minimizing or altogether preventing serious consequences. The steam turbine in this respect is a more or less closed volume, and therefore has to be taken largely on trust as to internal condition of operating parts.

The disposition to let well alone in the absence of trouble is human and often a species of laziness. It flourishes in invisible situations and mechanisms peculiar to diversity of circumstance requirements.

That it should be so is altogether wrong in principle. Concealment must always warrant oftener and more painstaking inspection than does constant tangible, visible and audible approach.

A break in the intake pipe of a city's water supply such as Toronto has experienced, is a case in point. Here we have a pipe concealed from view and approachable only by a diver, synonymous with our steam turbine to the extent that superficial knowledge available is valueless.

We make no claim to know or pass opinion on the frequency or quality of inspections made of the intake pipe referred to, but we do insist that the peculiar circumstances of each require a frequency and quality inspection of oft recurring systematic high standard.

In spite of it, however, there may arise unforeseen and unprovided for trouble.

Ample provision should be made for opening-up the turbine with minimum disturbance of accessory connections, obviating thereby any cause for neglect and want of knowledge of its vital condition.

Reduction of clearances does not in its economical aspect, warrant the involving of the attendant risks, and so long as casing distortion is a factor to be reckoned with, the disappearance of what were only delusionary clearances to start with, may be looked for from the variations of temperature between comparatively wide limits.

Short casings show less distortion than do long ones, and distortions of a purely local nature may be attributable to too rapid or incomplete warming up on starting. In the reciprocating engine this latter practice runs to trouble, and the steam turbine also shows its dislike by distortion and blade stripping.

The steam turbine is more addicted to cause priming than the reciprocating engine, its capacity for drawing steam being greater. Several cases of blade stripping have been credited to a heavy inrush of water along with the steam on a too sudden opening up.

The theory advanced, highly tenable and practicable is that the blades were first bent, or their binding disturbed or broken.

Faulty brazing of the blade lacing may always be more or less contributory to blade stripping, and segmental blading which is now common, lends itself perhaps to poor workmanship in greater degree than does the individual method.

Rotor Troubles.

Rotor troubles in the early days of turbine construction were largely in evidence. They have, however, been almost entirely eliminated by a change in material and method of building.

The boiler plate drum, internally butt strapped, stiffened by screwed stays and cast steel segments, has given place to the weldless steel drum stiffened internally by ribs turned out of the solid.

The cast steel spider for attaching the drum to the rotor shaft has been sidetracked in favor of forged steel with sawn or slotted out arms, thereby removing the tendency to arm cracking, common to the steel casting.

Lubrication Troubles.

Forced lubrication is usually adopted, that is the oil is pumped to the bearings under pressure.

In some cases, however, the oil is pumped to sight feed lubricators, from which the various bearing supplies can be seen to and regulated.

Turbine bearings may run safely at higher turperatures than those of reciprocating engines, and record is had by fitting thermometers to the various bearing oil wells.

A pressure of 1 pound per square inch is usually carried with forced lubrication, it being found sufficient and conducive to less leakage loss.

The lubrication of the bearings, etc., of the steam turbine must never cease while the machine is under operation else trouble of every kind more or less disastrous will be forthcoming.

Conclusions.

From what has been said, steam turbine troubles may be and are largely avoidable. The features of blade clearance and binding, rotor drum and spider attachment to rotor shaft, materials of construction, efficient lubrication, first-class workmanship and careful intelligent operation are one and all capable of and being realized.

This admitted, the steam turbine is without doubt in advance of the reciprocating engine, as far at least as freedom from operating trouble is concerned.

Personal and Societies

W. C. McGhie, chairman of the Ontario Stationary Engineers' Board, will visit during the week of March 20, Brantford, Simcoe, Welland and Hamilton, and during the week of March 27, Ottawa.

* * *

London Branch, No. 30, C.A.S.E., held a smoker and concert in their clubrooms, 211 Dundas Street, March 7. There were many engineers and their friends present. George Moll was chairman. The programme was as follows: Mr. Higgins, song; Mr. McDonald and Mr. Irwin, violin selections; Mr. Parker, comic song; F. Cavin, mouthorgan and guitar solos and stump speech; Mr. Stewart, song. Later, games were played.

* * *

A. B. Wilson, who has been connected with the Tungstolier Co., Conneaut, Ohio, for the past two years as their St. Louis representative, has been made vice-president and general manager of the Tungstolier Co., of Canada, with offices at Toronto.

* * *

Spencer & Campbell have been placed in charge of the Montreal office of Kilmer, Patten & Burnham, which has been opened on 11 St. Sacrament Street, Montreal.

* * *

The staff of the Cost Department of the Northern Electric Mfg. Co., Montreal, held their fourth annual dinner recently at the Arcade Hotel. Thirty members sat down. The chairman, John MacDonald, was supported by the heads of several departments, including E. C. Peterson, chief accountant; A. M. Ritchie, production; H. E. Warren, general sales; John Irvine, piece work rates, and T. H. Schelcher, bookkeeping.

* * *

Societies of engineers are finding the department of "Questions and Answers" in The Power House very interesting and profitable. Belleville Lodge, C.A.S.E. No. 34, are discussing them in the lodge room.

* * *

W. B. McPherson is the new president of the University of Toronto Engineering Society. The others elected are: Vice-pres., E. M. Watts; treas., F. Elliott; corres.-sec., A. McQueen; record. sec., H. A. Heaton; curator, R. G. Matthews; sectional vice-pres., civils and architects, J. E. Ritchie; mining and chemistry, K. McLachlan; electrical and mechanical, G. J. Michler; fourth year representative, W. Wright; third year, R. F. B. Wood; second year, F. C. Mechin.

At the annual meeting of the Electrical Association of the Province of Quebec, held recently in Montreal, the principal business was the election of officers and the executive committee for 1911.

* * *

Stratford Convention Notes.

The C.A.S.E. convention will be held in Stratford, July 25, 26 and 27. Every engineer should arrange to be present to hear the papers read and examine the exhibits of power specialties.

* * *

The secretary of the convention committee is A. Kastella, 48 Douro St., Stratford. Inquiries addressed to him will receive prompt attention.

* * *

Orders for advertising space in the souvenir should be addressed to A. Kastella.

* * *

The exhibitors are busy and requests for spaces are already being received. For information address, G. C. Keith, secretary of the C.A.S.E. Exhibitors' Association, 143 University Ave., Toronto.

* * *

The Stratford engineers are determined to make the 1911 souvenir the "best ever"; 1,500 copies are being issued.

* * *

Robert Patterson, the popular Master Mechanic of the G.T.R. shops, Stratford has been elected honorary president of the Stratford Lodge C.A.S.E. No. 31.

* * *

The city council is to be congratulated on its liberality. Free use of the city hall has been given for the meetings and exhibit and they donated a considerable amount towards the souvenir. It will be handsomely repaid in July when the large number of engineers and manufacturers visit the city.

* * *

After March 31 the address of the secretary of Stratford Lodge, will be Jas. A. Innes, 52 Devon St., instead of 56 Front St., Stratford.

* * *

International Union Steam Engineers.

The monthly meeting of the Toronto branch of the International Union of Steam Engineers was held in the Labor Temple, Church Street, Toronto, on the evening of Wednesday, 22nd February.

On completion of the usual society business, the meeting was opened to members and friends, local president Jones being in the chair.

The programme for the evening consisted of an address by W. C. McGhie, chairman of the Ontario Board of stationary engineers.

The subject, "Engineers' License Law," was fully explained and afterwards discussed. A vote of thanks to Mr. McGhie brought an interesting and instructive evening to a close.

* * *

The next open meeting will be held on Wednesday evening, 29th March, when a paper will be read by Peter Bain, M.E., associate editor, The Power House, Toronto. The subject will be "Is Your License your Rating?"

* * *

On Feb. 28, the Engineers' Union held a concert and dance in St. George's Hall, which was well attended and a big success.

* * *

Montreal Notes.

A correspondent from the commercial metropolis ventures the remark that "Readers' Queries" never come from that great engineering centre.

He impressed us with a suspicion of the cause why.

Another correspondent with his eyes open in a different direction notes an absence of contributed articles from Montreal engineers.

Putting one and one together, the "Readers' Queries" observant is wide of the mark as to "why" the blank to which he refers. We thought so.

The Power House is going well here, the engineers are a sleek bunch, say little because too busy digesting its contents.

They will tell you of the other cities and provinces all they know in good time.

An engineer remarked the other day to one of the MacLean representatives that to be without The Power House is like going around without his watch.

There is keen rivalry among us here individually. It has about the same application as waiting on a wealthy old relative going out.

We are testing out The Power House in the matter of keeping secrets. This accounts for our being gingerly in our news furnished.

Ontario has something worth copying from us in the way of graded licenses, and she won't be happy until she gets them.

We have a very superior type of engineer generally speaking in this old city and as a consequence we are naturally well off in every respect?

Refrigeration is a strong feature of our get-up, so don't get fresh or we will chill you.

Keep on delivering the "goods" to us as you are doing and Montreal will always cut a large figure in your subscribers' list.

Good luck to The Power House.

Boiler Design, Construction, Operation, Repairing and Inspection

By H. S. Jeffery

The Rivet Pitch.

(12) The rivet pitch is a matter which must be decided first, and then the other parts arranged. The pitch must not be so excessive as to permit the plates to spring between the rivets, and which will cause the rivets and seams to leak. No stated pitch can be given for a certain thickness of plate, or for a certain size rivet—the best that can be done is to set a maximum pitch for different types of riveted joints with different thickness of plate, and then use whatever size rivet as will permit the riveted joint to be properly designed.

The following formula gives the maximum pitch:

$$(C \times T) + 1\ 5\text{-}8 = P$$

Where:

C=Constant applicable from Table 1.

T=Thickness of plate in inches.

P=Pitch in inches. (See note*.)

TABLE 1.

Rows of Rivets..	1	2	3	4
C. for Lap Joints	1.31	2.62	3.47	4.14
Constant for Double Butt Strap joints	1.75	3.50	4.63	5.52

Example. With a single riveted lap joint, plate 3-8 inch, what is the maximum pitch?

Solution:

(1.31 x .375) + 1 5-8=2.116 inches, or 2 1-8 inches.

Double-Strapped Butt Joints.

(13) The majority of boilers are now constructed with double-strapped butt joints for the longitudinal seam. The lap joint does not permit making the boiler as round as does the butt joint, nor does the lap joint make it possible to make the efficiency of the longitudinal seam as great as when the double-strapped butt joint is employed.

In Fig. 17 is shown a single riveted double strapped butt joint. It is single riveted as the shearing of either of the rows of rivets will permit the sheets to separate, though the rivets are in double shear.

Referring back to the calculations of the single riveted lap joint, it will be seen that the efficiency of the net section of plate is 62.5 per cent., while the rivet efficiency is 44 per cent. For the sake of illustrating it will be assumed

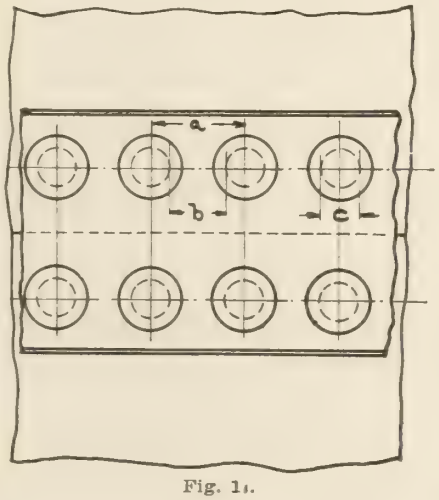


Fig. 17.

that the letters a, b and c, Fig. 17, represent the same values as in Fig. 12, which, of course, will mean that the efficiency of the net section of plate of Fig. 17 is 62.5 per cent.

But, the rivets being in double shear, increases their shearing strength, and thus their strength must be found and compared to the strength of the solid plate in order to determine the efficiency of the rivets. The shearing strength of the steel rivet in single shear was stated to be 45,000 pounds per square inch and that a rivet in double shear was 1.85 times 45,000 pounds, making 83,250 pounds.

Then substituting values, the efficiency of the rivet is:

$$\frac{.44179 \times 1 \times 83{,}250}{60{,}000 \times .375 \times 2} = 81.7 \text{ per cent.}$$

Attention is now directed to the fact that with the single riveted lap joint the rivet efficiency is 44 per cent., while with the single riveted double strapped butt joint (same size and pitch of rivets in both instances) it is 81.7 per cent. The efficiency of the net section of plate remains of course, 62.5 per cent. in both instances.

With the single riveted lap joint the efficiency of the plate exceeded the rivet efficiency, it being pointed out that to use a larger rivet would increase the rivet efficiency and likewise reduce the efficiency of the net section of plate.

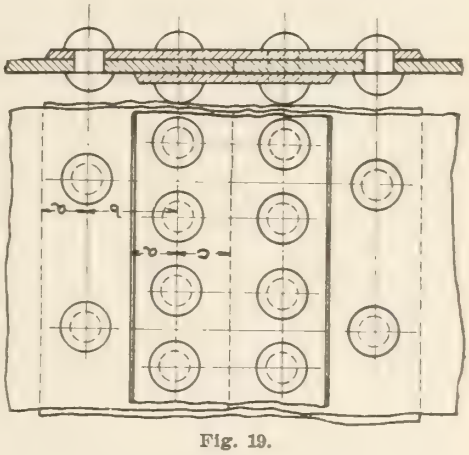


Fig. 19.

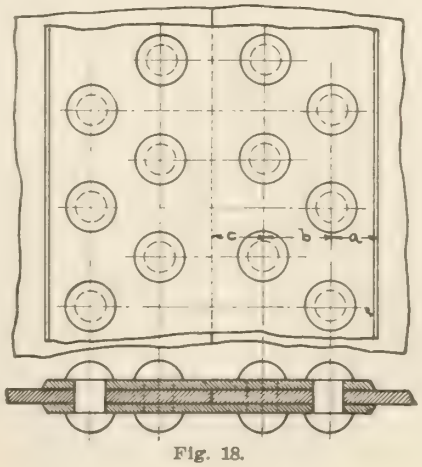


Fig. 18.

which would tend to equalize matters.

With the single riveted double strapped butt joint, the rivet efficiency exceeds the plate efficiency, thus indicating that the pitch might be increased so as to increase the efficiency of the plate and reduce the rivet efficiency.

Whether or not this course would be advisable relates only to the question as to pitching the rivets so as to make the joint steam-tight. The calculations indicate that the pitch can be increased to some extent, and now by referring to Table 1 and the formula in connection therewith this question can be decided.

* Note.—With a double-riveted double-strapped joint, as shown in Fig. 18, the constant from Table 1 is 3.50, while with the double-riveted double-strapped joint, as shown in Fig. 19, the constant is 1.75. This has only reference to the pitch of rivets in double shear. Thus the pitch of rivets for the inner row of the triple-riveted double-strapped joint, as shown in Fig. 20, will have the same constant, 3.50, as used for the double-riveted double-strapped butt joint, as shown in Fig. 18.

Example. With a single riveted double strapped butt joint, plate 3-8 inch, what is the maximum pitch?

Solution:

(1.75 x .375) × 1 5-8=2.28 inches.

As the pitch used in the calculations was 2 inches, it will be seen that this is below the maximum pitch allowed, and, accordingly the pitch can be increased, thus causing the efficiency of the net section of plate to increase while the rivet efficiency will decrease. It is advisable, however, to keep the rivet efficiency above the plate efficiency to some extent, and to do this may make it impossible to increase the rivet pitch to the maximum pitch.

In Figs. 18 and 19 are shown two types of double riveted, double strapped butt joints. In Fig. 18 all the rivets are in double shear; both the inside and the outside welt strap being the same

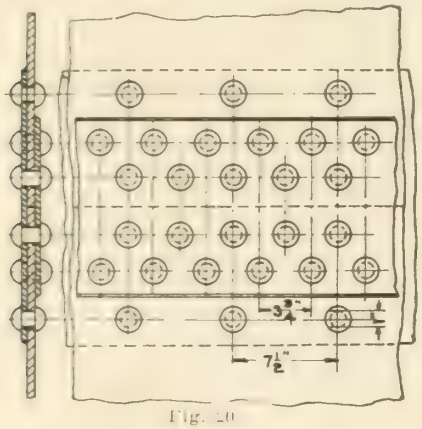


Fig. 20

width, while in Fig. 19 one row of rivets is in double shear and the other row in single shear; the inner welt strap being of greater width than the outer strap; also, the rivets in single shear are pitched twice as great as the rivets in double shear.

To compute the strength of the riveted joint, Fig. 18, first find the efficiency of the net section of plate and then the efficiency of the rivets, and the lower value of the above will be the efficiency of the riveted joint. Inspection of Fig. 18 shows that the pitch of rivets in both the inner and outer rows of rivets is the same, and accordingly, the efficiency of the net section of plate can be computed from either source.

Now, with the riveted joint, Fig. 19, the outer row of rivets, which is in single shear, are pitched twice as great as the rivets in the inner row, and which rivets are in double shear. Inspection of Fig. 19, and considering the foregoing remarks, shows that there is a minimum and maximum net section of plate, and that part of the rivets are in single shear and part in double shear.

In designing a riveted joint as shown in Fig. 19, or the triple riveted double strapped butt joint as shown in Fig. 20, which is only an extension of the double riveted double strapped butt joint, the riveted joint should be so designed as to make the weakest point the net section of plate of the maximum pitch of rivets.

To illustrate the manner of computing a riveted joint as Fig. 20, it will be assumed that the shell plate is ½-inch in thickness and of 60,000 pounds tensile strength; maximum pitch of rivets 7½ inches, and minimum pitch of rivets 3¾ inches, and rivet holes 1-inch in diameter and rivets of shearing, as used in former examples.

The efficiency of the net section of plate, maximum pitch of rivets, is:

$$\frac{7\frac{1}{2}-1}{7\frac{1}{2}}=86.6 \text{ per cent.}$$

The efficiency of the net section of plate, minimum pitch of rivets, is:

$$\frac{3\frac{3}{4}-1}{3\frac{3}{4}}=73.3 \text{ per cent.}$$

From these calculations it will be seen that the efficiency of the net section of plate at the inner row of rivets is considerably below the efficiency of the net section of plate at the outer row of rivets. However, to rupture the plate through the net section of plate at the inner row of rivets will require the shearing of the rivets in the outer row. Their efficiency must be found and added to the efficiency of the net section of plate at the inner row of rivets.

To obtain the efficiency of the rivets in single shear in the outer row necessitates comparing the shearing strength of the rivet with the solid plate, 7½-inch pitch, which is:

$$\frac{\text{(Area) } .7854 \times 1 \times 45.000}{60,000 \times 5 \times 7.5}=15.7 \text{ per cent.}$$

Then, the efficiency of the net section of plate of the inner row and the rivet in single shear of the outer row, is:

73.3+15.7=89 per cent.

The combined efficiency being greater than the efficiency of the net section of the plate, the efficiency of the riveted joint, in this instance, is 86.6 per cent. The riveted joint may rupture from other sources, and to make same plain the manner of computing a riveted joint will be carried further.

A cause of failure of a riveted joint is the shearing of all the rivets. With a triple-riveted double-strapped butt joint, as shown in Fig. 20, this mode of failure need not be considered, but with a double-riveted double-strapped butt joint, as shown in Fig. 19, it must be considered.

Continuing the calculations of the riveted joint, Fig. 20, it having been already found that the rivet in single shear has an efficiency of 15.7 per cent., the efficiency of the rivets in double shear, must be found and added to the efficiency of the rivet in single shear. The shearing strength of the rivets in double shear is:

$$\frac{.7854 \times 4 \times 45,000 \times 1.85}{60,000 \times .5 \times 7.5}=116.24 \text{ p.c.}$$

Then the combined efficiency of the rivets is:

116.24+15.7=131.94 per cent.

Distance Between Rows of Rivets.

15. The distance between the rows of rivets should at all times be sufficient to permit the rivets to be readily driven without cutting or disfiguring the head of the rivet when driving another rivet. The distance a, Figs. 18 and 19, which is the distance from the centre of the rivet hole to the edge of the plate, should be 1¼ times the diameter of the rivet hole. With rivets staggered, as shown in Fig. 18, the distance, b, between rows should not be less than 1½ times the diameter of the rivet hole, while the distance, b, of the riveted joint, Fig. 19, should be sufficient to permit the outer welt strap to be calked. The distance, c, of butt joint, especially the type of joint, as shown in Fig. 19, should be at least 1¾ times the diameter of the rivet hole.

Girth Seam Rivets Assistance.

16. With double-strapped butt joints, inner strap extended, as shown in Fig. 20, the net section of plate adjoining the girth seam will be less than the maximum net section of plate, this be-

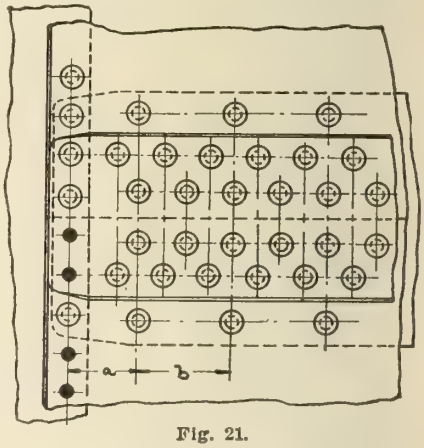


Fig. 21.

ing shown by the letters a and b, Fig. 21. The net section a is not, however, weaker than the net section b, for to rupture the net section a, will require a number of the rivets in the adjoining girth seam to shear, the same being indicated by the rivets in black. Usually the strength of the net section a, and two rivets in the girth seam is sufficient to make the calculations show the efficiency of these parts greater than the net section b.

CANADA PRODUCER AND GAS ENGINE CO., BARRIE.

That Canada is keeping pace with the development and manufacture of gas producer plants, gas and gasoline engines for power purposes, is evidenced by the successful operation and production of the Canada Producer and Gas Engine Co., Barrie, Ont.

Started little more than a year ago, a highly competitive line of manufacture has been established in gasoline engines for agricultural and jobbing purposes, illustrations of which are to be found in Figs. 1 and 2. The former is shown connected to a rotary pump. Both are hopper cooled and have the bed plate so arranged as to admit of the gasoline being stored there in lieu of a separate tank. These engine are of 3 horse power and meet a ready sale for a variety of purposes. The hopper cooling arrangement ensures a thorough circulation of water about the cylinder.

What, however, gives this company most prominence is their success in

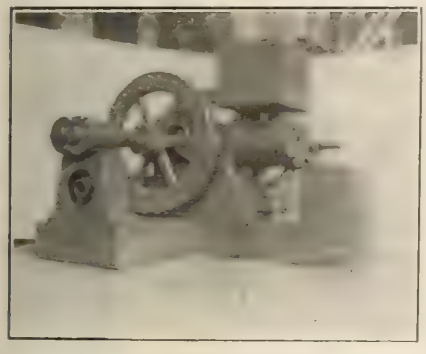


Fig. 1.—3 h.p. Hopper Cooled Horizontal Gasoline Engine Driving Rotary Pump, Canada Producer & Gas Engine Co., Barrie.

what may be termed the vertical gas engine and gas engine producer plants. Fig. 3 represents a complete 350 horse power plant, and Fig. 4 that of a 350 horse power vertical engine alone.

To have attained to the successful production of these in a comparatively short time reflects the highest credit on the management.

The works front on three streets, the total being 681 feet. The main building is occupied by the machine and moulding shops, with a storage building in rear. The erecting shop and power plant are situated in another section, while upstairs over the machine shop are located the offices, pattern shop and pattern storage.

Vertical gas engines are built on the four-cycle single-acting principle, permitting high speed with absence of vibration, a necessary requirement of electric generator driving. They are supplied in single, double, triple and quadruple cylinder style units, and are suitable for operation by producer, natural and illuminating gas, gasoline or distillate.

The various detail parts show liberal proportioning, simplicity and certain durability in service, while accessibility

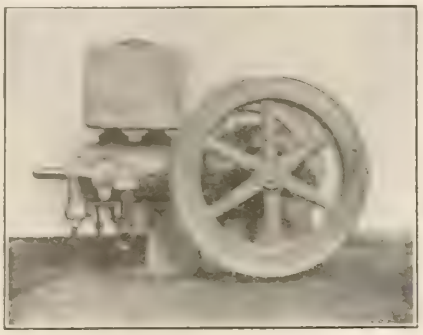


Fig. 2...3 h.p. Hopper Cooled Horizontal Gas or Gasoline Engine Without Bed Plate, Canada Producer & Gas Engine Co., Barrie.

and ease of adjustment are amply provided for.

The producer plants are built in sizes from 40 to 500 horse power in single units, and in multiple units to meet any requirement. They burn anthracite coal, coke, charcoal, lignite coal and some refuse material.

The company's exhibit at the last Canadian National Exhibition, Toronto, was awarded a silver medal and diploma. It had the distinction, too, of being the only purely Canadian exhibit of producer gas engines.

THE BRINE COOLER.

The brine cooler possesses advantages over direct expansion coils, in the opinion of some authorities, owing to there being but one valve for use in regulating, and the easy and immediate determination of capacity by means of thermometers. To produce one ton of ice, one gallon of brine must be circulated per minute by the pump and cooled through a range of five degrees, or a greater quantity through less range. H. J. Botchford has stated that it will require approximately 300 pounds of steam per 24 hours for every ton of ice made to pump brine.

CANADIAN BRANCH BRITISH MANUFACTURERS.

The associated firms of W. T. Glover & Co., Royce, The Howard Asphalt and Troughing Co., The Ashover Fluor Spar Mining Co., all of Manchester, England, have secured offices in the Lumsden Building, Toronto, for the purpose of direct representation on and supply to the Canadian market of the various specialities produced and manufactured by them. These latter consist of underground cables and wires, electric cranes, and direct current motors and dynamos, asphalt troughing for underground conduits and fluor spar for steel smelting.

C. S. Mallett who will be in charge and manage the Canadian business is renewing his connection with the Dominion after an absence of 12 years, all of which time he spent at the various firms' headquarters he now represents.

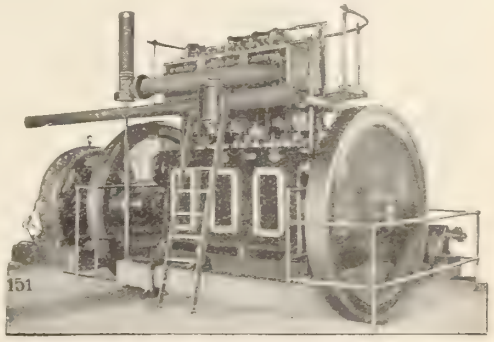


Fig. 4.—350 h.p. Gas Engine, Canada Producer & Gas Engine Co.

The scope of the business to be undertaken will include reporting and advising as to the best and most suitable equipment required, the supply, delivery and erection supervision of same and the furnishing of prompt and complete tenders, plans and specifications.

The composition of babbitt metals as specified by the Bureau of Steam Engineering of the United States Navy, should be 88.8 per cent. banca tin, 7.5 per cent. antimony, and 3.7 per cent. copper. The metals should be well fluxed with resin and borax in mixing.

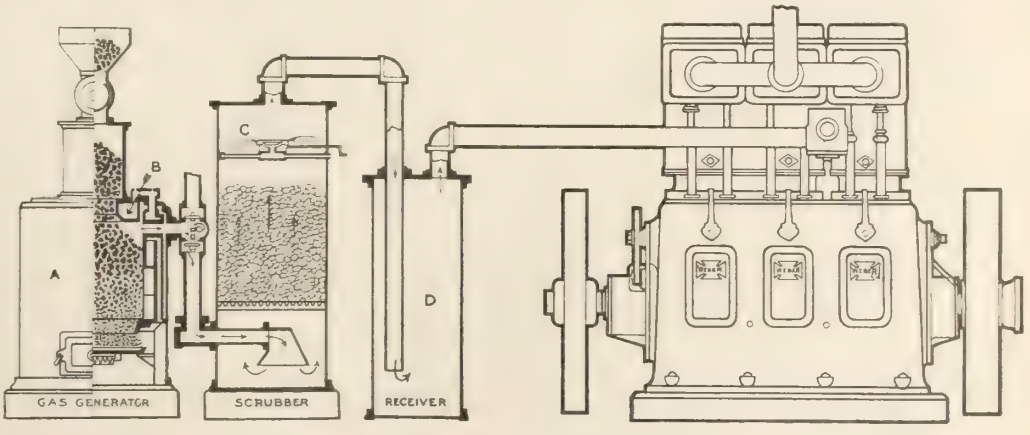


Fig. 3.—Elevation of Producer and Engine, Canada Producer & Gas Engine Co., Barrie.

Progress and Development of Hydraulic Engineering

By Penstock

No Apology is Necessary for Our Featuring Hydraulic Engineering in Canada. This Country Lends Itself Naturally to a Development and Progress Along the Lines of Every Description of Water Power Equipment, and the Idea in This Particular Section of Our Paper is to Make Known What is Doing and Who is Doing it Throughout the Whole Field.

CENTRIFUGAL AND TURBINE PUMPS.

Rotating pumps known as centrifugal, low pressure, turbo and multi-stage have made rapid strides during the past few years as public utilities. They are being adopted for all descriptions of pumping work such as that required in mines, docks, sewage, fire, condensing and boiler feeding.

In modern power stations coupled to a steam turbine, the centrifugal or turbo pump makes a neat, compact unit, requiring the minimum of attention.

Advantages.

The motion being rotative and the impellers being accurately balanced, vibration is altogether eliminated and foundation cost thereby reduced to a question of soil or location.

Compactness compared with ram or plunger pumps commends the centrifugal type in installations where space counts.

Adaptability to vertical or horizontal drive, direct coupling and consequent obviation of gearing losses, contribute to reduction of working and wearing parts.

In a well designed and constructed pump there is really nothing to get amiss or seriously out of order. Packing of the glands, attention to lubrication and occasional adjustment of the thrust bearing are the principal requirements to be overtaken. As compared with reciprocating pumps they do not depend on internal valves for their operation.

Details.

The impellers or revolving discs are specially designed for each pump purpose, in the matter of diameter and vane angle, and their material is largely determined by the nature of the liquid to be handled. This latter feature is a consideration in the pump as a whole.

The conversion of the kinetric energy of the water due to the impellers, into pressure energy necessary to overcome the head, is effected by means of guide vanes. These latter attain this purpose without shock and unnecessary expenditure of effort, by reason of the fact that the water enters them at the same angle as that at which it leaves the impellers and quits them at a much wider angle.

The various passages are designed to avoid, as far as possible, losses due to change of velocity, and experience goes to show that a maximum speed of 4 feet per second is the most desirable.

With a view to miminizing skin friction, surfaces in contact with the water flow are polished.

To prevent the formation of air pockets and the accumulation of dirt or grit, particularly when sewage or dirty water is being pumped, bends in the various waterways are avoided.

Efficiency.

High efficiency records are being made by manufacturers of centrifugal and turbine pumps, of which the undernoted are a few that have come under the observation of the writer :

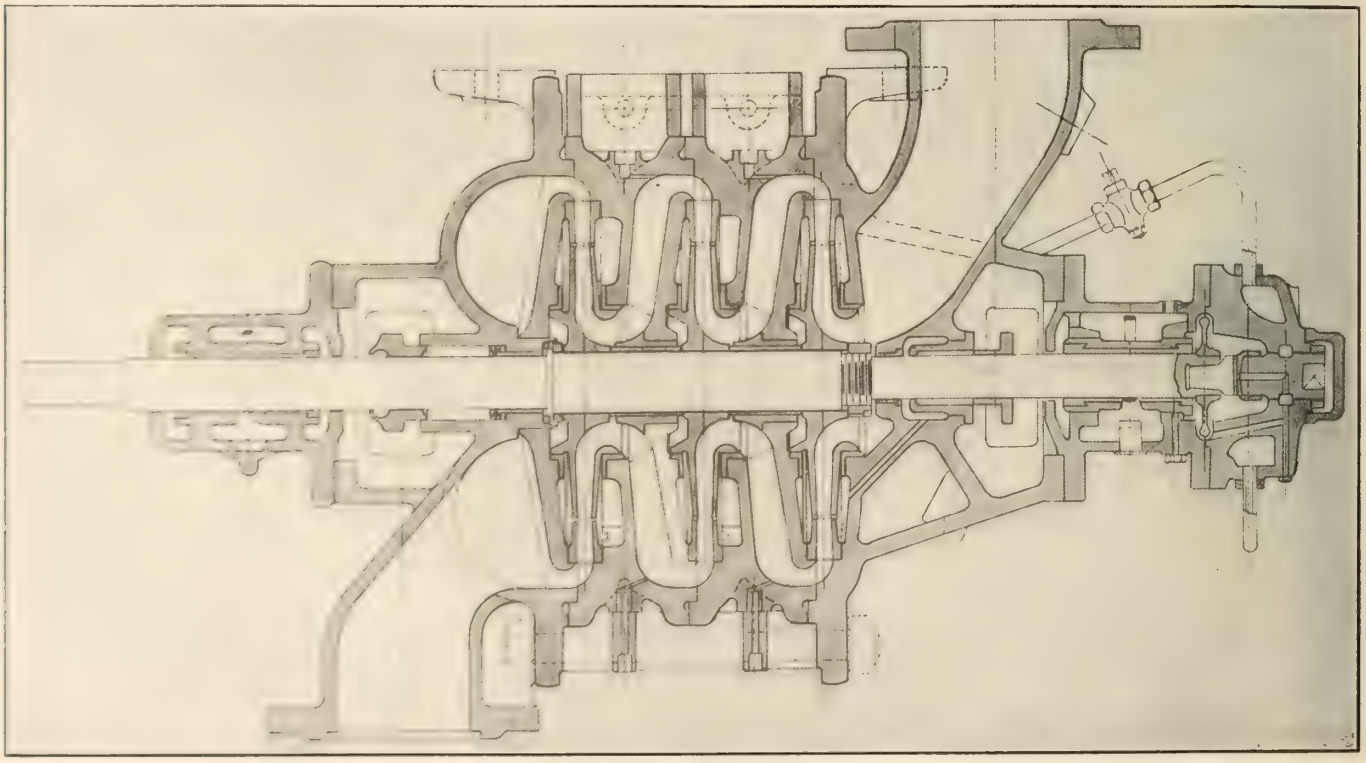
Low pressure centrifugal pump.—4400 gallons per minute, 40 feet head, 76 per cent. efficiency.

High pressure 2 stage centrifugal pump.—286 gallons per minute, 135 feet head, 77 per cent. efficiency, 5 inch branches.

High pressure 4 stage centrifugal pump —345 gallons per minute, 216 feet head, 1325 revolutions per minute, 68 per cent. efficiency.

High pressure 4 stage centrifugal pump.—395 gallons per minute, 315 feet head, 1450 revolutions per minute, 67 per cent. efficiency.

High pressure 5 stage centrifugal pump.—150 gallons per minute, 203 feet head, 1560 revolutions per minute, 63 per cent. efficiency.



Longitudinal Sectional Elevation 3-stage Turbine Pump.

ELECTRICITY VS. HYDRAULIC POWER.

At the Rothesay dock on the Clyde there was recently installed a complete set of electrically-driven machinery to replace the hydraulic equipment formerly in use. It was found from a careful comparison of the two systems that the installation costs were practically alike, but that in operation the advantage lay with the electric power, due in large measure to the variable nature of the work. The electric power was also suitable in circumstances which did not admit of the hydraulic equipment being used. Both showed equal economy when under full load.

THE PULSOMETER PUMP.

The pulsometer is a self-acting steam pump without pistons, and is largely used on account of its handiness, particularly for temporary work. The steam consumption according to the work done would not be considered economical in a permanent installation.

Operation.

Steam is admitted at the pipe K and follows the direction indicated by the arrows into the right hand chamber A, forcing the water there past the discharge valve F to the delivery pipe.

While this is taking place a partial vacuum has been formed in the left hand chamber A due to condensation of the steam. This causes the suction valve E to open, filling the chamber and causing the ball valve I to roll over to the right, closing it and admitting steam to the left, where a similar process to that described goes into operation.

The chambers AA are filled and discharged alternately, one filling while the other is emptying and all automatically.

WATER SUPPLY OF CITIES.

Progress in the design, simplification and improvement of pumping engine equipment, due largely to the introduction of high pressure steam, has marked the water supply of cities and towns in a special manner.

Local conditions have in all cases an important bearing on the ultimate arrangements made.

Water supply from wells is usually obtained from a depth not exceeding 300 feet, beyond which, pumping expense becomes an item of serious importance.

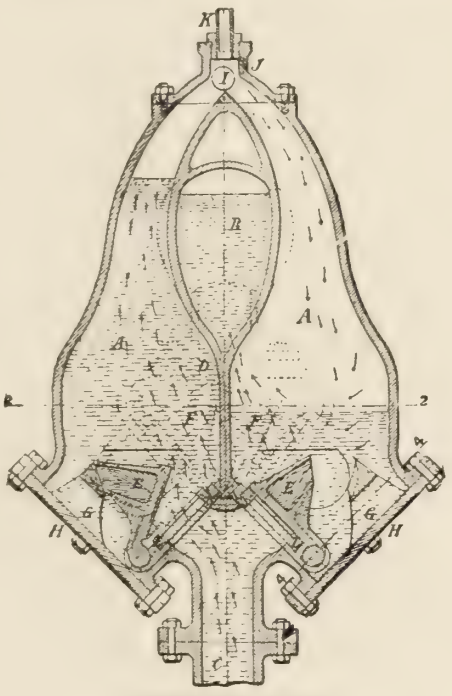
With a river as the source of supply, filter reservoirs become a necessity or should be so, in which event a set of pumps is required to draw the water from the river and deliver to the filters and another set to distribute the filtered water to the mains. These latter are usually of small power, large capacity and of the centrifugal type, simple in construction and compact

Where a natural head of water is available, water pressure pumps may be used, in which case economy of operation is obvious. Pumps of this type are used to supply water to locations higher than the source from which their own operating power is derived. The water pressure pump is on a par with the centrifugal in simplicity and operating attention.

The reserve of a waterworks pumping plant should be based on the maximum daily demand in summer and the individual unit reserve should be at least 25 per cent. for large and 50 per cent. for small engines.

Pumping direct into distributing mains is not desirable but when unavoidable the reserve power of the engines should be materially increased, because the variation of demand during 24 hours necessarily exceeds the mean supply.

One day of 24 hours should be the period covered by the capacity of the service reservoir.



Pulsometer Pump.

AUTOMATIC VACUUM BREAKERS.

When condensing engines are liable to be lightly loaded for any length of time, it is especially desirable to provide a safety-device that will break the vacuum when the water rises to a certain height in the condenser. If this is not done, the condenser may be flooded and the engine wrecked, should the speed of the air-pump slacken.

Safety-devices arranged to shut off steam in case the engine starts to race, should be arranged to break the vacuum at the same time. Even when the steam is shut off the vacuum is often sufficient to speed up an engine under no load to a point where the wheel is burst by centrifugal force.—The Fidelity and Casualty Co.

LACOMBE, ALTA., TURBINE INSTALLATION.

The Madison Williams Mfg. Co., Lindsay, Ont., have shipped to the municipality of Lacombe, Alta., a horizontal turbine placed in a steel case with cast iron elbow, intake pipe and draft tube. The turbine is a Madison Williams 30-inch. "Triumph" design, which develops 250 h.p. under 25 feet head. On the turbine shaft is a heavy cast iron split pulley 86 inches diameter, 25 inch face. This turbine is used for the lighting plant at Lacombe.

TESTING A WATER METER.

Will you kindly give me a practical method of testing a water meter.—B. A.R.

You can weigh the water that passes through the meter. One Imperial gallon weighs 10 lbs., and a cubic foot weighs 62.4 lbs. Two tests should be given, one when the water is drawn rapidly, and one when the water is drawn slowly. By using a barrel and scales, weigh the water and compare with what the meter shows as having passed. The meter gives the number of gallons which can be reduced to pounds by multiplying by 10.—Editor.

COAL DUST EXPLOSION EXPERIMENTS.

Experiments already carried out by the Mining Association of Great Britain to determine the phenomena of coal dust explosions have shown that, under favorable conditions, such explosions can be made to occur. When a jet of dust was ignited in an artificial gallery, a large cloud of dust was ejected, and a flame shot out of the mouth of the gallery, spreading through the dust to a distance of 180 feet. The report of the explosion was audible for a distance of seven miles.

Consideration for subordinates is a good trait. Treat the oiler, fireman and others just as you would have the manager treat you. It is not necessary to knock off hats or swap chewing tobacco or act the good fellow generally, just to show them that you think them as good as yourself. Courtesy and fairness is all that the competent man asks. Familiarity breeds contempt, and deservedly so, but in no place more so than in a power plant.—Ex.

Many salesmen lose a possible sale by talking too much to the engineer. Very few engineers are hired for the purpose of serving on reception committees, at least not during working hours. Tell the engineer what you have to sell, and why you think he should use it—then stop. Don't ring in any personal history or bring your knitting along for the afternoon.—Ex.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV MARCH, 1911 No. 3

THE FIELD FOR REFRIGERATION IN CANADA.

That the fields for refrigeration in Canada is growing is shown by the interest taken in the subject by engineers and manufacturers generally and by the increasing number of installations being made. Plants are now used for the production of ice, cold water or for cold storage. Refrigerating machinery is now made for all classes of plants, large or small and for electric drive or any other motive power as steam or gas.

The Canadian installations of refrigerating apparatus at the present time include dairies, creameries, restaurants, hotels, hospitals, meat markets, candy factories, breweries, apartment houses, packing plants, including meat, fish, fruits, etc.; warehouses for storing and shipping perishable goods, office buildings, fur storages, departmental and grocery stores, steel plants, etc. These are a few of the many and varied successful applications. In southern countries the use of refrigerating machinery is more general being used for the manufacture of ice, but Canada is tapping the world's markets and refrigerating and cold storage plants have become a necessity for

⊙

BOILER EXPLOSIONS.

A prominent engineer and author of several well-known marine engineering publications, referring to the British Board of Trade and Lloyds Rules for the constructional details of steam boilers, says, "That he indeed would be a bold man who would choose to depart much from either and be responsible for it."

Notwithstanding it seems as though many bold men and equally many careless and conscienceless men are abroad in the boiler field to-day, if one may judge from the almost daily record of boiler explosions.

Our contemporary, Power, is authority for the statement, published in its columns a few weeks ago, that two boiler explosions occur in the United States per working day throughout the year.

Freak design, poor constructional strength and workmanship to cheapen production cost, homeless and itinerant boilers, misguided and misdirected on their way to the melting furnace by greed and fraud, incapacity of operators, lack of competent supervision and inspection all contribute to this awful blot on the fair name of the engineering profession.

Freak design is usually the outcome of an originally laudable ambition for fame and profit on the part of someone with a badly balanced brain or without this all-important commodity in his being. In saying so, we are merely repeating a commonplace, as "the woods are full of them" and we have ceased to look upon them as a curiosity. The old reliable established designs are still standing the test and will require boldness and brains of super-quality to oust them.

There is "wild-catting" and "exploitation" in the boiler world as well as in the mining world and wherever these conditions exist some interests suffer.

Poor constructional strength and workmanship are deliberate and therefore criminal, because there are none in the boilermaking business to-day but know full well what is required of them and what should be. Fierce competition is no excuse for bringing the danger point down from its lofty pedestal. The elimination of danger is a world purpose to-day, and if you cannot join in it, get out of the business and take up something else wherewith you can.

The homeless and itinerant boiler (second-hand is too high grade in the majority of cases) menaces the public safely continually until the final squeeze comes and it goes out by the roof or end wall. The companionship of old bedsteads, spring mattresses and burnt-out kitchen stoves is neither conducive to an assurance of its quality nor to the integrity of its owner.

The unfortunate thing about this class of boiler is that it gets beyond the ken of engineers the moment it becomes homeless, and remains an outcast and wanderer until between a knave and a fool it bursts, damages property, kills or maims somebody. No improvement can be expected until drastic legislation compels registration and record of all boilers and their vicissitudes from baptism of water to destruction by fire. Scrap purchase entries in the ledger should not be easy of change to boiler sales.

Incapacity of operators, lack of competent supervision and inspection are causes of boiler disasters which are gradually, if slowly, disappearing. An educative influence is making itself felt towards display of intelligence and reason in the treatment of steam boilers.

Operators, owners and inspectors in general, realize that there is credit and profit to be had in giving this power source due attention. The unskilled man is, however, to be found around boilers in country districts especially and the problem of how best to reach him is a serious one. An additional feature of this situation and making it doubly serious, is the fact that in many cases his boiler is of the untracked and undefined class to which reference has already been made.

Revolutionary changes and developments are in progress in the engine field and point to more exacting requirements of the steam boiler to carry them out.

In view of this it becomes daily more imperative that boiler laws should be increased in stringency to safeguard the public from freaks, frauds, knaves, fools and ignorance.

The record of boiler explosions in Canada is highly complimentary to the various interests concerned in their prevention, yet in view of the more exacting demands of to-day, let eternal vigilence continue to be the price we pay for it.

SELLING SERVICE.

Recently the editor of The Power House called on a Canadian agent of a steam specialty house. In conversation with him and in endeavoring to find out the reason of his success, he made the remark, "I am not selling traps I am selling service." When one considers why one salesman succeeds and another fails, why one company goes ahead when another is compelled to put the shutters on its windows, he can usually find an answer to his thoughts in the fact that one sold a machine and the one sold service.

A company that sells service will not be content with seeing a machine installed. He will see that it works. In so doing he makes a friend and a possible market for future sales. Suppose an agent or company sells a machine that is afterwards thrown out, it means a loss financially as well as in reputation and sooner or later the shutters will be put on the windows while CONTINUED SUCCESS WILL ATTEND THE MAN OR COMPANY WHO SELLS SERVICE.

VALUE OF ASSOCIATIONS.

Wm. Cooke speaking at a recent banquet of Stationary Engineers in Belleville, made reference to the work of the C.A.S.E. What he said is applicable to any organization of engineers that stands for the assistance of the engineer and raising the profession.

He said that for five years he had been a member of the C.A.S.E. and it had helped to get him along in the world. It was always a pleasure for him to attend a C. A.S.E. meeting as he had learned much. "If we attend meetings," he said, "and do all we can for the association, it would improve our minds in the line of engineering."

A PLEA FOR WELL-SELECTED IGNORANCE.

The call for well selected ignorance is a universally personal message to all classes and conditions of men. It takes for granted that from choice, indifference or circumstance, a degree of ignorance exists and is cultivated.

We are daily acquiring knowledge of some sort (being educated if you like) without much effort in its pursuit.

Idle curiosity leads to its attainment, but it is knowledge of no moral and commercial value.

A superficial smattering of the principles underlying one's business or occupation is also an acquisition of knowledge. Contentment with it, however, displays choice and cultivation of ill-selected ignorance ; the antithesis of our subject.

Our purpose here is not to treat the matter in its wider application, rather is it to bring before our readers the fact that they have many superfluous frills in their trade get-up which a better selected ignorance would be the means of their becoming wise to.

Experience goes to show that men have an antipathy to let their equals know the extent of their knowledge, or put in another way and with the same meaning, the extent of their ignorance.

Further, when opportunity offers by which valuable information is to be had for the asking, there is experienced that display of selfpride whose result is ill-selected ignorance.

The picture drawn is no fanciful one and every reader can take it home to himself and say "that's me." We are all built that way unfortunately but need not as a consequence remain altogether and all the time under the thraldom.

Get a beginning made now to help shake it off, by cultivating a well selected ignorance which is equivalent to the acquisition of a thorough detail education, involving the principles, the "whys and wherefores" of your business, and the grasp of every opportunity to add to it.

It will save you many a hard knock, harder I assure you than the wounding of your pride by choice, to an inferior or equal. It will make a man of you as well as an engineer and if you cannot command success, you will at least deserve it.

BONUSING FIREMEN.

Premium systems and bonusing systems have been installed in a great many plants. While many mechanics and other help in the factory enjoyed a bonus on each pay day the fireman never found a fattened envelope ready for him. His pay was easily counted—one day, $2; six days, $12. It was a safe guess what he would receive at the end of the week.

A way has been found in which firemen may be remunerated for efficient work. It is a comparatively easy matter to check their work by having analytical tests made of the flue gas. The composition of the flue gas and the amount of CO_2 it contains depends on the care in firing, therefore, by paying the fireman a bonus according to the CO_2 in the flue gas, it will ensure good firing. This plan is being used by several U.S. concerns and with good results.

How it may be done, is this: Ideal firing gives about 17 per cent. CO_2 in the flue gas. For this a maximum of 30 cents per day could be allowed, and then 25 cents for 15 per cent.; 20 cents for 13; 15 cents for 11; 10 cents for 9 and 5 cents for 7 per cent. No bonus should be given for less than this. If the simple tests for CO_2 are not sufficient basis for the payment of a bonus, a CO_2 recorder can be purchased which will register automatically the amount of CO_2 gas present and show the efficiency of the fireman's work.

ONTARIO STATIONARY ENGINEERS' ACT.

In the February issue of The Power House, reference was made to the new Act being taken up at the present session of the Ontario House. Another change in addition to that mentioned has been made. This refers to Article 6, which now reads, "No person shall be eligible for examination unless he is a British subject or has resided in Canada for at least one year."

WHAT ARE YOU PAYING FOR POWER?

"CAN I PRODUCE MY OWN POWER IN MY OWN PREMISES AT LESS COST THAN IT CAN BE PURCHASED FOR FROM THE OUTSIDE?" This is a question that should be asked by every engineer and manufacturer in Canada. There is so much political talk and general newspaper stories that one is apt to become enthused with some particular class of power. The question should be taken up from the points of reliability and economy and a full discussion of and investigation into the power question as affecting each particular plant, will tell you whether gas, steam, or electric power will be best for your needs. Secure a competent unbiased power engineer and enter fully into the question before deciding.

Power "free as air" is surely an extravagant statement, but CHEAP POWER is a possibility. Water falls are scattered over the Dominion with power going to waste, steam plants are giving still greater economy since the introduction of the exhaust turbine and the economy obtainable from a gas engine is becoming well known. A careful investigation of the problem as affecting each individual plant is necessary if CHEAP POWER for that plant is to be obtained.

ELECTRICITY FOR STATIONARY ENGINEERS

COOLING ELECTRICAL MACHINERY

By Copper.

RECENTLY at an International Congress of Refrigerating Industries at Vienna, Austria, a paper was read by Paul Garnier on the above subject, in which he suggested a new application for refrigeration. He referred to the loss by heating in such machines as generators, motors or transformers where one form of energy is converted into another. Some extracts are here given from the paper as reprinted in "Ice and Refrigeration."

Machines have been made so as to assure good cooling, and for this purpose they have been provided with ventilating passages divided into cross partitions and requiring fans, but the amount of heat allowed has been increased. It might also be noticed that the working temperatures allowed in the machines have been constantly on the increase and it seems as if the limit has now been reached.

In a report recently given by Mr. Brunswick to the International Society of Electrical Engineers on the "Temperatures allowable in dynamos and methods of determination thereof," during the work of the first section of the committee he stated the following principle: "That a temperature of 100 degrees C is a safe limit for continuous and indefinite working. It seems, in fact, that cotton can remain at this temperature for a long time without becoming appreciably changed, but the same cannot be said of higher temperatures such as 110 degrees or 120 degrees for instance."

This narrow margin of 10 degrees to 20 degrees beyond which the durability of the machine would undoubtedly be lessened, may seem insufficient, and it is certainly preferable to endeavor to increase the efficiency of a machine by means of cooling so as to work at the lowest possible temperature.

The transformer, consisting as it does of stationary parts, is, of all electrical apparatus, the one for which cooling has been studied most. Transformers are immersed in petroleum contained in metal vessels provided with ribs for cooling, some of which are provided with separate radiators; the oil is caused to circulate by variations in density. Cooling is sometimes effected by a circulation of water in a special coil of pipes.

In spite of precautions taken to make the circulation of air more active, the energy which it is possible to conserve without exceeding the heating limits allowed still remains very limited in value. Hence high powered machines must of necessity be constructed so as to have small losses, that is to say, so as to have an excellent output.

It appears difficult to work at temperatures higher than those usual at present, and even with the use of new insulating materials elevation of the temperature would have other disadvantages due to expansion. At least, until substances are found which are better conductors than copper, or more permeable than iron, the only means of increasing the power of a machine is to increase the current tension in the copper, and the induction in the iron, which increases the loss in any given machine. The loss increases more quickly than the current tension and the induction, that is to say more quickly than the power, which means lowering the output. Lowering the output is not always a disadvantage. Since the maximum amount of heating is now permissible, the efficiency must necessarily be increased by cooling. The ventilating passages and fans in large machines are becoming insufficient; these must therefore be provided with refrigerating pipes, through which water or a refrigerating liquid circulates. It would be advantageous for the moving parts to have circulated through them air previously refrigerated instead of air at the ordinary temperature.

ELECTRICITY IN THE REFRIGERATING PLANT.

By Frigid.

The increased use of electricity in Canada due to the development of water powers, will no doubt result in the operation of refrigerating machinery in the electric zones, or at least the smaller units, by electric power. Among the machines to be operated are the ammonia compressor, brine pumps, fans, etc., depending on the systems adopted

The amount of power for a refrigerating plant is taken at from 2 h.p. to 2.5 or even 3 h.p. per "ton of refrigeration." The term, "ton of refrigeration" is the amount of cooling a given plant will supply, and is the cooling effect of a ton of ice spread over 24 hours. If the plant is for ice making, it must be remembered that one "ton of refrigeration" will produce only ½ a ton of ice per day. This is the rule used by refrigeration experts.

Hotels, dairies, creameries, restaurants, hospitals, meat markets, candy factories, ice cream plants, etc., can operate such small plants required by them, by motor to advantage. The lower cost of the plant and buying power by meter or flat rate for 10 hours or during the day time allows the small user to get the benefit of a refrigerating plant. In these places the load would be during the day so that a central station could be kept running continuously furnishing power during the day and lighting at night.

In large plants for cold storage where steam is used, it will be found convenient to use electric power for the use of fans on the various floors. In fact this is the process generally adopted. Power is also easily transmitted for elevators. The growth of the use of electricity in the refrigerating plant has resulted in manufacturers of refrigeration machinery and cold storage plants, constructing motors designed especially for this class of work, though a motor, suitable for the current obtainable, of course, may be used. The sizes vary from 1-3 h.p. to 300 h.p., depending on the capacity of the plant. Provision may be made at the option of the purchaser, for belt or silent chain connected motor..

In a small plant installed in a meat market, a motor was belt connected to a five ton refrigeration unit. The machine was started in the morning by the butcher himself, and closed down by him at the end of the day. This clearly illustrates that the electrically driven unit is especially applicable to the smaller plants at least.

COMBINED ELECTRIC LIGHTING AND REFRIGERATING PLANT.

By M. E. D.

The demand for refrigeration and refrigerating machinery is increasing in Canada, and shippers of perishable products, packers, etc., are finding cold storage an absolute necessity. This offers a field for co-operation between the small electric light plant and the packing and shipping industries.

In small centres where the production

of electricity is not very great, it hardly pays to generate the power. In fact after the manager, engineers, bookkeeper receive their salaries there is nothing left for the investor. Where there is a demand for cold storage, however, the electric plant can be operated the year round and a fairly good profit be made.

One great advantage secured by combining the electric lighting and refrigerating plant is the equalizing the load during the year and hence the profits. The demand for light is greatest in the winter months, while for cold storage the reverse is the case. Thus, when there is little income from electric lighting, that from cold storage will be greatest.

An engineer who can operate an electric lighting plant can by a little observation and study soon become familiar with a cold storage or refrigerating plant. By following the instruction of the engineer who installs the plant, reading his technical paper studiously, and perhaps securing a book on the subject, he can become quite proficient in a short time.

Such installations as the one to which I have referred, have been made in the southern states of the United States, and are attended with great economy. In some of them ice is made, but at the present time the field is small in Canada though it is growing, some companies finding it cheaper to manufacture ice than harvest it and ship it to market. For small centres, about which I am writing, there is usually a demand for cold storage and the opportunities in this direction at the present time are numerous enough to be well worth considering this co-operative scheme.

ELECTRICAL "SPARKS."

By K. Campbell.

E. M. Fitz, electrical engineer, Pittsburg, has devised an ingenious scheme for cars, for overcoming the brittleness of the tungsten lamp filament when not burning. The method consists in having a small current pass through the lamp when extinguished. On cars using 63 volts (32 cells), the two end cells of the battery, giving four volts, are connected to the lamps when extinguished. This keeps the filament at a faint dull red and makes it as strong as that of a carbon lamp. Recent tests show that the life of a tungsten lamp will vary from 1,500 to 2,000 hours when this method is followed.

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Germany is to have a transmission line for transmission of current at a pressure of 110,000 volts. This is probably the highest voltage used in transmission in Europe. The current is three-phase, generator pressure is 5,500 volts which is stepped up by four transformers of 6,800 k.w. capacity.

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The master mechanic in a textile mill in Norrkoping, Sweden, came in contact with the high-tension conductor to the mill, carrying a pressure of 3,000 volts. The current was conducted through his body to the ground, and while he lost consciousness, he afterwards recovered. The visible effects were comparatively small, the hair only being singed. This is a very unusual case.

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According to an explanation of lightning given by H. D. Brown, the electricity discharged between two clouds or between a cloud and some object on the earth decomposes the small particles of water in the atmosphere into its constituents. The hydrogen and oxygen thus produced are mixed mechanically and form an explosive mixture which is immediately ignited by the heat of the flash, and when exploding produces the characteristic rattling report of thunder.

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Cost of Electrification.

The cost of electrifying the main and suburban lines within fifteen miles of Boston has been estimated at $32,751,942, of which six million represents the cost of the generating system of 60,000-kilowatt capacity, and nearly four million the cost of the transmission lines and overhead system, says "Scientific American." The outlay for electric locomotives is placed at a little under seven million, and it is estimated that the multiple-unit motor cars will cost a trifle more. The multiple-unit trail cars will cost about five million. This covers the electrification of the New Haven and the Boston and Maine lines, with 461 miles of track, and a daily service of 14,630 train miles.

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A Simple Current Test.

A letter published in a recent number of "Power" suggests a simple method of determining whether the current in a lamp socket is alternating or direct. On holding one pole of a permanent magnet against one side of the globe of a lighted lamp, it is found that if a direct current is flowing through the filament, the latter will be either attracted toward or deflected from the magnet, while if alternating current flows through the lamp, the filament will vibrate, due to the alternation.

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Water Storage versus Storage Battery.

A writer in the "London Electrician" suggests that it would be more economical to use water storage in power plants in place of storage batteries, the idea being to provide motors for pumping water when the load is light, and to use these motors as generators driven by Pelton wheels during the peak load. To illustrate the advantage of such a system, he assumes the case of a 10,000-kilowatt plant with a spare plant of 2,500 kilowatts in the form of lead storage batteries, steam generators, for his proposed water storage. By providing a shaft of a thousand feet with a reservoir of 14,160 cubic yards at the bottom of the shaft, he concludes that the capital cost of the water system would be $130,000, and annual charges $11,100, as against $160,000 capital and $20,975 annual cost for storage batteries, and $187,500 capital and $21,500 annual charges for steam.

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Electricity and Fence Wire Rust.

Investigations to discover the causes of rusting in galvanized wire have been undertaken by the agricultural engineering department of the University of Iowa, Ames, Iowa. It has been well known that the lower wires of the fence, down among the moist grasses and weeds, where rusting action would be expected to be most active, invariably last longer than the upper wires in the dry air. M. L. King, experimentalist for the department, says he has found that these lower wires in fences of any length ordinarily carry small currents of electricity, reaching in some cases a value as high as 0.001 ampere, and sometimes showing a difference of potential of as much as 1 volt above ground. Such currents are absent in the upper wires, and it has been suggested, but not proved, that the greater preservative action of the lower strands is due to the suppression of local electric couples by the through currents flowing in the lower wires.

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Change in the Value of the Volt.

Since the first of the year the National Bureau of Standards has adopted a new value for the standard volt in United States to correspond with that in England, France and Germany. The change, while numerically very slight, will be felt in the incandescent lamp industries. The change is based on the value of the Weston cell at 20 deg. C. Heretofore, we have rated the cell at 1.091 volts; now the rating is 1.0183 volts.

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Losses on High Tension Lines.

In a paper read by Mr. West before the American Institute of Electrical Engineers, the relations between voltage and losses on transmission lines, by reason of coronal discharge, were discussed.

He found by tests on the lines of the Central Colorado Power Company that with tensions of 50,000 and 60,000 volts on a line 180 miles long, the loss was not serious, even though the conductor was but 289 mills in diameter. But above a critical voltage of 75,000, the loss increased greatly, particularly under no-load conditions, but this loss could be reduced by using larger conductors.

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Purchase of Electric Power.

The current used by the electric locomotives in the Detroit River tunnel is purchased from the Detroit Edison Company, and is stepped down from 4,400 volts to 650 volts direct current by a sub-station. The energy, says the "Electrical World," is purchased on a maximum-demand as well as a k.w.-hour basis, which makes it necessary for economical operation to eliminate as far as possible excessive peaks from the incoming lines. A storage battery has been installed to take care of the fluctuations of load, and the regulation devices are such that the first 800 amp. are taken from motor-generator sets; then the battery takes care of the load from 800 amp. up to 8,360 amp.; that is, the battery takes 7,560 amp. Anything above this figure is again taken from the motor-generators. The maximum load is 9,100 amp. When this load is being carried the motor-generator sets would be delivering 1,540 amp. (their full load rating) and the battery would be supplying 7,560 amp.

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Electricity Brought Down by Rain.

A series of observations made in India by B. C. Simpson are published in a recent number of the "Electrical Review and Western Electrician," which show that electricity brought down by rain may be positive or negative. The total amount of positive electricity recorded was 3.2 times the total quantity of the negative electricity, and the period during which the positively-charged rain fell was 2.5 times that of the negatively-charged fall. Treating the charged rain as equivalent to a vertical current of electricity, the current densities were generally less than 4×10^{-15} amperes per square centimeter, but on a few occasions greater current densities, both positive and negative, were recorded.

ELECTRICAL QUESTION ANSWERED.

We can buy electricity at the rate of 12 cents per kilowatt hour, said current being at a pressure of 110 volts. Will it cost any more for electricity to burn two 25 watt, 55 volt lamps connected on the series system than one 25 watt, 110 volt lamp connected direct?—T. Kurtz.

Yes, it will cost twice as much.

CASE 1. Cost to burn two 25 watt, 55 volt lamps connected in series across 110 volts for 100 hours.

In this case the number of watt hours $25 \times 2 \times 100 = 5{,}000$.

1,000 watts=1 kilowatt.

1,000 watts consumed for 1 hour, i.e. 1,000 watt hours=1 kilowatt hour.

5,000 watt hours=5 kilowatt hours.

1 kilowatt hour costs 12c.

5 kilowatt hours cost $12 \times 5 = 60$c.

CASE 2. Cost to burn one 25 watt, 110 volt lamp connected across 110 volts for 100 hours.

No. of watt hours $= 25 \times 1 \times 100 = 2{,}500$.

$$\text{Kilowatt hours} = \frac{2{,}500}{1{,}000} = 2.5.$$

2.5 kilowatt hours cost $2.5 \times 12 = 30$c.

The relation between watts, volts and amperes in such a case is: watts=volts $\times$amperes. The confusion of the enquirer probably arose by not realizing that the 55 volt lamp has a filament with one-half the resistance of that of the 110 volt lamp. Having the same power rating, and only one-half the voltage, there will be twice as much current flowing through the 55 volt lamp to make it use the same power.—C. L. Gulley.

MOTOR TROUBLE.

By R. McLaren.

Recently a motor armature in one of our factories burned out. The cause was general debility, due to long neglect, such as improperly fitted and placed brushes, dirt, oil, etc. Another motor was installed in its place and on starting or trying to start it there was a display of fireworks. I was appealed to for help, and found that the motor would run a little but was evidently taking too much current as the starting box got hot. After fitting the brushes and making some adjustments another trial was made, the starting box still got hot and there was evidently heavy current flowing through the brushes. Shifting the brushes did no good because when one set would be in the right position another would be wrong. The spacing of the brushes was next tested with the result that some of them were found to be a ½-inch out of position. This would be bad enough on a thick brush, but as these were about ½-inch thick it was worse.

An attempt was made to get them right by moving some of them backward and some forward, but this method proved to be unsatisfactory so a strip of paper was wrapped around the commutator in order to get its circumference. As it was a 4-pole machine the circumference was divided by four. The quotient was the distance the brushes had to be apart at their point of contact with the commutator either from toe to toe or heel to heel. They were then set and refitted, and the motor has since been running without giving trouble.

VACUUM DUST REMOVER.

By James E. Noble.

No doubt a great amount of trouble is caused to engines and machines through dust and grit reaching bearings, etc. Dust is responsible for much of the trouble to electric generators. Did you ever notice an attendant with brush and bellows trying to get all the dust out of generators, motors, switchboards, etc.? It is a slow and by no means sure job.

Take a glance around any shop where there are pulleys. Dust galore will be found in many of them for if the attendant attempted to remove it with bellows and brush much damage might be done to the shop contents.

A vacuum cleaning outfit costing say $150 would remove all trouble from dust. The vacuum floor broom or brush would remove dust from walls, floors, ceiling, etc. The machine would also remove dust from pulleys or any place possible to reach with little trouble and small cost. I have not got a vacuum apparatus myself, but I have heard about those who have and would be glad to get first hand information from some engineer with a vacuum outfit, giving the cost of operation, amount of work saved and any other detail of interest.

VACUUM DUST REMOVER.

I think the idea of the "Vacuum Dust Remover" is a good one though I use compressed air for all the motors in our shop. It will not be hard to arrange a vacuum system as it is used in street railway work for cleaning cars. One good feature that should commend the vacuum system is that the dust is sucked out of crevices and this cannot be accomplished by the pressure system. —Hamilton Manufacturer.

CORRECTION.—In our leading descriptive article on the Carels Drop Valve Engine made by Douglas & Grant, Kirkaldy, Scotland, for the Balgonie Colliery Co., Fifeshire, the kilo-watt output should have been 510, instead of 150 as stated. The footnote under the illustration of their advertisement on page 31 should have read Carels Drop valve, instead of Recals Drop Valve Engine.—February Power House.

Pipe covering which has become unsightly and soiled can be made to look as good as new by first removing all loose dust and giving it a coat of whitewash in which enough salt has been dissolved so that it will not rub off.

Correspondence

Discussion on Previous Articles—Readers' Queries and Comments. Remuneration for useful Ideas

ANSWERS—A. F. MORAY QUERIES.

(1) The pressure will be greatest on the cylinder cover studs at the beginning of the stroke, as it is subjected to full boiler pressure.

(2) The plain slide valve only uncovers one port, which necessitates a large valve travel. The gridiron valve (as its name implies) is a series of bars or grids, and each bar uncovers a port, requiring a smaller travel for the same opening. The result is a quicker steam admission and cut-off, especially when used with a releasing gear of the Corliss type. There is less wear and tear with the shorter travel.

(3) The Brombo pulley makes the lever-reducing motion more accurate, because, by its use, the cord follows a straight line.

(5) The weight of the pulley on the shaft will be the same, whether it is running or stopped. The centrifugal force in a revolving pulley tends to pull it apart, and the forces pulling down on one-half of the pulley are just equal to the forces lifting on the other half (if I might use this expression). Were this not so, we should be able to run a pulley at such a speed that it would be able to lift the shaft in the bearings.

(6) I should think one would be as bad as the other. Where a blow-off has a free outlet, the pipe should be supported, so that the back-lash caused by the rush of water would not spring the pipe and fittings sufficiently to rupture them.

With long pipes and sharp bends the same holds true, since the water in changing its direction at the bends, gives out its energy somewhere, and if the rush of water is sudden or excessive, something will give way.

(8) This is a question not easy to answer, and depends on the method of applying the oil to the cylinder. In my opinion, the hydrostatic lubricator takes more oil than a force feed lubricator, because in the first instance the feed varies with the temperature, whereas the force-feed is constant. The right amount can only be found by practice.

(9) There is a trap made that will take the water of condensation from a pipe that has a pressure less than atmospheric. The Bundy trap will do the trick.

(11) With a short connecting rod, the valves must open quicker and easier than an engine with a long connecting rod, especially on the head end, as the piston moves away quicker from the head end than the crank end. This is due to the effect of the angularity of the connecting rod. The shorter the rod the more pronounced is the effect.

(12) It will depend on the kind of plant, and the fuel burned. Some plants find it cheaper to install a fan engine and burn cheap coal, even though they may have a fair-size stack. Others, again, get along nicely on natural draft, burning a fair quality of coal, and using economizers to catch some of the heat from the waste gases to heat the feed water.

(13) A tank pump is built to pump against a small head, or pressure, and the water cylinders are larger than the steam cylinders. A pump of this type will deliver more water per stroke than a high-pressure pump, because in high-pressure work the water cylinders are smaller than the steam end.

(14) The syphon should discharge more water, since the weight of water on the discharge side is much heavier than it otherwise would be if the pipe were the same size all through. It is natural to suppose that the water on the discharge end, having a greater pulling power (due to the extra weight of water) will draw more through the other end.

(15) Theoretically it should last longer. Practically I don't think it would. There are very few things that can withstand a constant fire heat, without deteriorating, and this is what happens to a boiler. Besides, I should say a constant heat would tend to make the plates brittle in time.

(16) In a condensing engine, steam is not compressed in a vacuum. When the exhaust valve closes, there is some steam left in, or otherwise no compression would be obtained, there being nothing to compress.

In looking over some cards taken from a triple-expansion engine, the exhaust line is about 10 lbs. below the atmospheric line, and the exhaust valve closes at about five-sixths of the return stroke, which leaves some steam for compression. In the case of this engine, the card shows a compression of five lbs. above the atmosphere just before admission.—J. C. Tweedale.

WHAT WOULD YOU DO?

"Youngster," Georgetown, Ont., suggests the following procedure in answer to "What would you do?" in our correspondence section of "The Power House." January issue.

If it were a large size stopcock, the first thing occurring to me would be the bight of a chain which I would put on the square of the cock in a loop, so that when a pry or lever was applied to the free end, the plug of the cock would turn.

If there was no chain handy I would smother the fire with ashes or coal, check the draft and keep the feed pump going. This smothering of the fire would prevent intense heat reaching the boiler shell, and make dense smoke which would tend to coat the plate and tubes with soot and prevent over-rapid cooling.

A. G. F., Rainy River District, Ont., suggests want of forethought on the part of the engineer in not having a duplicate set of wrenches hung up convenient and not locked in a box. He further states that he would not think of blowing off unless his fire and steam pressure were both suitably low.

STATIONARY ENGINEERS' WAGES

While we all sympathize with "Jim Scotch," in his plea for higher wages for stationary engineers, and agree with him that many employers don't do all they might with respect to this question, there seems to me a large possibility that a good deal of the fault and cause for low rating lies with the engineers themselves.

Compared with many trades, operating engineers are poorly paid, and compared with the same trades they are quite as intelligent and do their work as well. This being granted does not raise their standard of efficiency and sufficiency, it rather, I think, weakens their case. Influences that possibly operating engineers cannot control to their benefit, help these others outside of extra individual personal intelligence and ability.

My advice born of a fairly long experience in various capacities among operating engineers, ashore and afloat, is that they cultivate a larger knowledge of the business than what is necessary

to secure even a first-class license. He is not a fireman by a long way because he can shovel coal into a steam boiler furnace, neither is he necessarily an engineer because he holds a first-class license.

Too much stress is laid on the fact that the license makes the engineer, and too much contentment is the result of its achievement. I happen to know a good deal more of the qualifications of operating engineers in all the provinces of Canada than does "Jim Scotch," and while the statement made by a correspondent to an engineering journal a short time ago that "some are not fit to run a baby car let alone an engine" is wide of the mark, it serves to show that there is room for improvement.

Don't, therefore, begin at the wrong end, but let every operating engineer individually and in his society raise the standard of knowledge of his profession and its intelligent application, by the doing of which monetary recognition is bound to be secured, and a trade standing gained which will be more lasting than that got by agitation along lines of comparison with other trades.—Oilcan.

C. A. S. E. BUTTONS

Where can I obtain C.A.S.E. buttons, and what is the price?

C.A.S.E. buttons may be obtained from W. A. Crockett, executive secretary, Mount Hamilton, P.O., Ont., at 50 cents each plus five cents for postage.

LAP JOINT LONGITUDINAL SEAMS

A. F. Moray writes accusing "Blackrock" of dodging his question. Now if A. F. M. knew "Blackrock" a little better he would not dream of imputing any such thing to him without more reason. A. F. M. in his query says: "I fail to see where the abuse of a boiler will have any effect on the longitudinal seams as they are seldom exposed to the fire, and heavy firing, scale and oil have no effect on them."

"Blackrock" did not make a statement that the life of the return tubular lap jointed longitudinal seam boiler should be limited to seven years because heavy firing, scale and oil affected it on account of its being exposed thereto.

If Mr. Moray will read the article again carefully, under the heading, "Cause of Ultimate Failure," he will find as follows: "The outstanding feature of weakness in the lap joint is the treatment that the steel receives in the offsetting process necessary to this construction. This initial punishment it undergoes lays the foundation for aggravation when the completed boiler in service carries with it the uncircular offset of its shell plate joint."

If I have dodged the issue it was unconsciously done in following A.F.M. into new territory.

The point A.E.B. makes is whether a man having fractured his right arm below the shoulder will play ball longer than one with his limb unimpaired.

Correspondingly will a boiler joint subjected to slogging treatment during construction be as reliable as that which does not get or require it.

A. E. B.

BOILER DESIGN, CONSTRUCTION.

My attention has been directed to the remarks by "Laddie Cliffe" on page 51, February issue of "The Power Hause," who criticised at length the writer's article appearing in the January issue of the aforesaid publication. His remarks are interesting, likewise amusing, and I have arrived to the conclusion that there is considerable truth in that saying: "A little knowledge is a dangerous thing."

I am glad to note that my remarks have been a "revelation" to him, particularly that part relating to the design of a tubular boiler. "Laddie Cliffe" asks the question: "Now where does the design come in?" It is apparent from his remarks that he labors under the impression that steel mills manufacture standard lengths and widths of shell plates. Now, I do not think that "Laddie Cliffe" has ever ordered many shell plates, whereas I have ordered thousands of them, and I have always had to state the length, thickness and width of plate desired—the standard of the steel mills was my standard—the steel mills have no standard of their own.

Perhaps, sometime in the future—I fear it is a long ways off—there will be standard rules and regulations in regards to boiler designing, etc., and then it will be possible for the mills to furnish "standard sizes" of plates. At present due to the rules and regulations of different States, Provinces, cities, etc., a boiler may be allowed 100 pounds steam working pressure per square inch in one place, while the same boiler in another place would be allowed more and in another place would be allowed less.

If "Laddie Cliffe" thinks it is nothing to design a tubular boiler, why not follow out his line of reason and apply it to all boilers? This we cannot do for the reason that we would be going up a blind alley. "Laddie Cliffe" says that the diameter of the boiler, thickness of shell plate, number of courses, diameter and number of tubes, etc., are matters chiefly to "suit the fancy of purchasers." Just imagine a man who knows nothing about bracing a boiler, stress to which the various parts of the boiler are subjected, heating surface, grate area, and many other things too numerous to mention, designing a boiler according to his particular fancy.

"Laddie Cliffe" says: "Nobody expects a boilermaker to be a boiler designer." It appears from this that "Laddie Cliffe" has taken upon himself the responsibility of speaking for the whole universe. For myself I cannot subscribe to his line of reason, and I am sure that there are a great many others that will not agree with him. I have no hesitation in stating that the best boiler designers in Canada and the United States are men who are practical boilermakers.

I can name three men at present who served their time under the writer and who are to-day boiler designers for large concerns. I have received from boiler manufacturers in recent years a number of letters asking me to recommend to them a party to fill the position as boiler designer, and invariably they have stated that they prefer a man who is a practical boilermaker. I think it is a false position to take that a man who is a practical boilermaker is not qualified for any better position.

I can name a number of large industrial corporations and railroads who are doing their utmost to make the men in their employ understand that they should qualify themselves for the better positions and I think I can show conclusively if called upon that our best boiler designers, machinery designers, etc., are practical men in their chosen field. I am not endeavoring to argue with "Laddie Cliffe"—what I am endeavoring to do is to reason with him providing he is open to reason.

"Laddie Cliffe" says: It is somewhat late in the day to say that the riveter or flue-man is not a boilermaker." I challenge his statement. I know of at least one thousand men who are employed by various corporations to-day as riveters—they do nothing else but drive rivets—they are specialists in that line. They are on the pay roll as riveters; they are paid as riveters; and "by jings" they are riveters. I also know of a vast number of men who do nothing but install flues; likewise I know of a vast number of men who do nothing but chip and calk, and while these men are at times spoken of as boilermakers, they derive this name merely because they are employed in a boiler shop.

Of course, the all-around boilermaker can rivet, flange, chip and calk, and perform all other such duties, but in the larger shops in Canada and the United States the specialist comes first and the all-around boilermaker comes next. I sincerely regret that all-around boilermakers are becoming scarcer and scarcer every day, but notwithstanding that

this appears to be the age of specialists, I desire to state that any one who desires to get ahead in this world can do so, if he will apply himself.

In conclusion, Mr. Editor, permit me to state that in presenting to your readers a series of articles I was not unmindful of the fact that many of the subjects which I will present will not be new to all the readers of "The Power Hause." Indeed I am rather under the impression that the readers of "The Power House" are all progressive and intelligent people, and instead of their learning matters of importance from myself, I will perhaps learn considerable from them, and I am greatly obliged to "Laddie Cliffe" to be informed that there is no such thing as a design of a tubular boiler—that nobody expects a boilermaker to be a boiler designer, and that he stands ready to criticize my further articles.

Surely, this brings home the old adage "He who criticizes you is a friend," and to this end I prefer to leave matters between "Laddie Cliffe" and myself.

H. S. JEFFERY.

Reply—H. S. Jeffery.

The personal pronoun "I" occupies such a prominent place in the H. S. Jeffery letter that the real issue he was called upon to defend, has been lost sight of.

"Oh wad some power the giftie gie him,
To see himself as ithers see him."

LADDIE CLIFFE.

READERS' QUERIES.

H. M., Winnipeg, Man., wants to know the amount of weight to be placed on a safety valve lever, particulars of the equipment being as follows:

Length of lever, 18 in. from fulcrum to inside of hooked end: distance of fulcrum to valve centre, 3 in.; valve diameter, 2¾ in.: boiler pressure, 100 lbs. per square inch by gauge; upward pressure of steam necessary to lift valve and lever without weight, 20 lbs.

• • •

B. E. T., Toronto, asks answers to the following questions:

1—Q.—How far are pumps supposed to throw water?

2—Q.—Why does the injector put water into the boiler?

3—Q.—If the eccentric gets loose, how would you fix it?

• • •

O. R., Lethbridge, Alta., requires information as to the heating of an office building and boiler blow-off outlet.

The office building is situated 300 feet from the power plant, and is of about 80,000 cubic feet capacity.

1—Q.—What size pipe would be required if laid underground?

2—Q.—Which would be preferable to use—radiators or pipe coils?

3—Q.—If radiators, whether direct or indirect radiation?

4—Q.—Would a steam trap be necessary at the end for discharging into the city sewer?

5—Q.—In connecting a blow-off pipe from a boiler to the city sewer, would a blow-down tank be required, or may direct connection to the sewer be made? The sewer is about 100 feet from the boilers.

• • •

G. F. H., Millbrook, Ont., asks answers to the following questions:

1—Q.—What steam pressure should be allowed on a boiler 50 in. diameter, with shell plate .318 in. thick, and having tensile strength (ultimate) of 60,000 lbs. per square inch?

2—Q.—Will it be harmful for me to fill up my boiler with cold water by means of a hand pump, six or eight hours after it has been emptied out and the fire gone?

3—Q.—Has the water in a boiler a higher temperature when under steam of 100 lbs. pressure than under steam of 40 lbs. pressure?.

4—Q.—On page 39 of the December issue of The Power House, water is stated as consisting of 8 per cent. oxygen and 1 per cent. hydrogen. What is the 1 per cent. unstated that goes to make up 10, the whole?—G. F. H. has not read the item correctly, as per cent. is not mentioned.—A.E.B.

5—Q.—What is meant by pitting?

6—Q.—How would you line up an engine?

7—Q.—What does the word "compression" mean when referring to the valves? For instance, lap on the valve is to give the engine "compression."

8—Q.—Why is it that a pump will not pump hot water?

9—Q.—Is there an estimated tensile strength of a boiler, or how do you get it?

• • •

We are much indebted to those readers who have furnished us with these questions pertinent to the operating engineer's business. They are expressive of the desire on a man's part to make the "reason why of things" form a unit of his equipment.

We have a suspicion that the same questions and a host of others have arisen in the minds of many engineers and remain unanswered.

An opportunity is afforded our readers to look into the matter and to give us their views in the way of correct answers.

These should reach us not later than 1st April, and acknowledgement will be made in that month's issue of The Power House. In any case, A. E. B. will incorporate them in our "Question and Answer" section of the same number, as a supplement to the others.—Editors.

QUESTIONS AND ANSWERS.

Louis Brodeur, Crescent Valley, B.C., suggests another method of proving that a steam boiler is twice as strong in the girth direction as it is longitudinally, and incidentally takes exception to the answer given by A. E. B. to question 13.

The boiler contribution we don't think adds to or simplifies the method already shown to attain the result and we have not therefore published it

Regarding answer to question 13, I am going to ask Mr. Brodeur to explain why the exhaust pipe on a steam engine is larger than the steam pipe, and why the area of a safety valve is less for a high pressure boiler than it is for one of low pressure, other conditions being the same. The same reason determines the solution of question 13 as determines these, and affords an opportunity of widening the scope and helpful influence of Mr. Brodeur's query.—A. E. B.

BOOKS FOR OPERATING ENGINEERS.

We receive numerous inquiries from our readers concerning the most suitable books that will enable them to qualify for engineer licenses of all grades.

The task set us is an easy or hard one depending on the definition of the word "suitable." What, from a general standpoint might be all right for the requirements of some engineers, would probably be all "Greek" to others and so on.

Books, practical training and the acquirement of knowledge by class or individual instruction, are each of themselves only the help and complement of the other. Personal study and investigation also, are necessary supplements.

Our view of the whole thing from a mature experience of teaching engineers and mechanics, is that a man state his individual wants in the shape of questionings that occur to or are forced upon him, to some reliable person or source, and not be bashful or rest till he gets satisfaction.

Our "Questions and Answers" in conjunction with the "explanation of the principles involved," form a highly educative medium. Will operating engineers therefore send us each month a list of questions for which answers are requir-

ed and we will do the rest. From the queries received we will be better able to recommend suitably supplementary books.

It is preferable to have all answers to questions with the necessary explanations, pass through the columns of our paper, because the originator of any question is only one of a number of others who need the like information To neglect sending us your queries and being therefore shut out from the necessary knowledge, is one reason for our editorial, "A Plea for Well-selected Ignorance."—Editor

SYSTEM OF CYLINDER LUBRICATION.

By B.A.S.C.

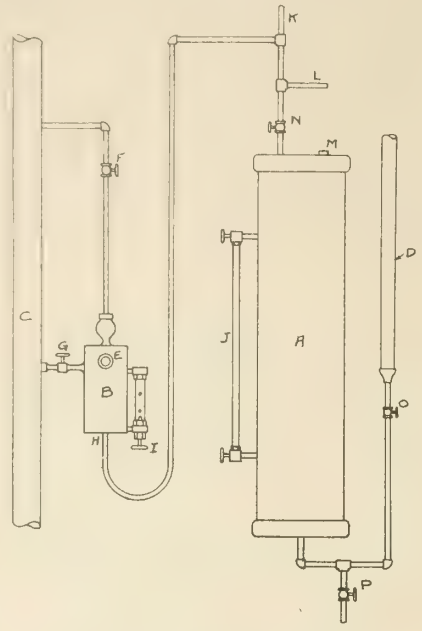
Where there are a number of pumps and engines each with individual lubricators, as is the usual custom unless closely watched, the reservoir of the lubricator has a tendency to run short, allowing the cylinder to operate without oil. This was the experience of F. Hutchison, engineer for the Mason & Risch Piano Co., Toronto, as he experienced considerable difficulty from night men, etc., not attending the lubricators carefully, particularly in the case of the feed pumps which were frequently neglected, causing such severe scoring that reboring was at times necessitated.

To overcome this difficulty, and to centrallize the control, he devised the scheme shown in the accompanying sketch. The system consists essentially of a cylinder A, made from six inch wrought iron pipes, with pipe caps, feeding a lubricator B, on the steam pipe C. The steam necessary to operate the system supplied by pipe D, in the lower end of which the steam condenses the full boiler pressure, is through the system from D to the lubricator B. In the lubricator, valves E and F are kept closed, and G open constantly. This means that the pressure from tank A will force oil through the system to steam main C, through the needle valve I, and through the open valve G. The pipe from tank A connects to the lubricator at H where the lubricator drain is usually found. The latter is unnecessary in this system.

The height of oil in tank A is shown by gauge glass J. Any number of lubricators can be connected to this tank as shown by broken connections K and L. The tank is filled through the plugged hole M, after first closing N and O, and opening P, the latter to drain the condensed water which has been replacing the oil consumed.

By this system, the only valve that the operator needs to touch is the needle valve I, on each machine and, as the tank A is large enough to last upwards of six weeks, there is no danger of scored cylinders from that cause.

As at present in operation by Mr. Hutchison, there are only three 6 x 6 duplex pumps connected, and, for each



System of Cylinder Lubrication.

pump, he has calculated that not more than a gallon of cylinder oil per month is necessary. The system is to be extended to include the whole plant.

INTERNAL CORROSION OF BOILER TUBES.

An exceedingly interesting and so far unexplained, case of internal corrosion in boilers, is that of the steamship Liverpool, a vessel plying between Liverpool and Sligo. It also shows the advisability of not relying entirely upon superficial appearance, as an indication of the thickness of a boiler plate or tube. The Liverpool has two Scotch boilers which were made in 1909. They are single ended, 12 feet 8 inches diameter, by 10 feet 6 inches long, each having three corrugated furnaces of 3 feet inside diameter, and three separate uptakes. Each boiler is fitted with sixty-six stay tubes, external diameter 3¼ inch, and thickness of metal 5-16 inch, also 166 plain 3¼ inch diameter tubes of 9 w.g. thickness (.144 inch), working pressure 163 lbs. per square inch. All tubes are of B.B. iron. One of the tubes collapsed March 16th last, with the result that a fireman was fatally scalded, and the chief engineer badly so.

On examination it was reported that all of the plain tubes were practically worn out, having been in work thus for less than twelve months. The boilers were rusty inside all over, and a deposit of black mud was found, apparently given off by the tubes. An examination of the tubes after removal showed that the thickness varied from the original amount, that is, .144 inch, to .064 inch; the maximum thickness at the lower half of the tubes was .116. The corrosion had occurred principally on the lower sides of the plain tubes, the upper sides and the stay tubes being only slightly affected. There were no signs of pitting, the corrosion being evenly spread over the whole length of the tubes between the end plates, so that their condition gave no indication of the wasting away which was taking place. Two tubes had been removed three days previously, and on this account the corrosion was unsuspected, the examiner judging entirely by their appearance. If the precaution had been taken to weigh them, the loss of metal would have been discovered, and doubtless the whole lot would have been renewed, and loss of life prevented. It is suggested that the corrosion may have been due to presence of air in the boilers, as they were filled up with fresh water on the first trip, and a month later, when much red mud was discovered inside, with water from the River Sligo. Again two months later, scale ⅛ inch thick was found in the furnaces but not on the tubes.

It is known from investigation, that carbonic acid gas is destructive to the interior of boilers. The confusing point is, why has the corrosion practically confined itself to the undersides of the plain tubes? Zinc plates were fitted to guard against electrolytic action.—National Engineer.

BOOK REVIEWS.

AMERICAN CIVIL ENGINEERS' POCKET BOOK By Mansfield Merriman, assisted by I. O. Baker, C. B. Breed, W. J. Douglas, L. A. Fischer, A. Hazen, F. P. McKibben, E. R. Maurer, R. P. Miller, A. Noble, F. E. Turneaure, W. L. Webb and G. S. Williams; 1,380 pages, 944 figures and 495 tables; bound in Morocco; for sale by Renouf Publishing Co., 25 McGill College Ave., Montreal; price, $5.

The outlines of this new Civil Engineers' Pocket Book were drawn up in 1908 by Mansfield Merriman, and the editors mentioned above invited to assist in the preparation of the work. The new book necessitated two years of arduous work, but the result is a credit to the editor of it and his associates. The book is divided into thirteen sections, including: (1) Mathematical Tables, (2) Surveying, etc. (3) Roads, etc., (4) Materials, (5) Concrete; (6) Foundations, etc., (7) Timber Structures, etc., (8) Steel Structures, (9) Hydraulics, (10) Water Supply, etc., (11) Dams, etc., (12) Mathematics, (13) Physics, etc. These thirteen sections contain 75 chapters, 620 articles, 495 tables and 944 numbered figures, which are equivalent to about 1,200 ordinary cuts. Sections 2 to 11 deal with civil engineering proper. The work will be found a valuable one to all civil and consulting engineers, containing, as it does, all the necessary data and tables, with the principles underlying them and applications of same. The arrangement of all this valuable material is also worthy of comment. This has been done to avoid duplication and yet give full information on each subject. The subject matter has been carefully indexed, the index covering 66 pages.

TRANSACTIONS OF GAS ENGINEERS FOR 1910—Annual report, edited by Walter T. Dunn, secretary, 39 Victoria St., Westminster, S.W., England; 494 pages. Some of the subjects treated are: "Public Lighting from a Municipal Point of View," "Management of Small Gas Undertakings and Works," etc. Included are the "Standard Specifications for the Manufacture and Testing of Retort Materials," recently completed by the Refractory Materials Committee.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

UNIQUE AIR COMPRESSOR.

THE Standard Mfg. Co. have in operation in Toronto a large up-to-date sanitary enamelware factory. Compressed air is extensively used throughout the works, a large quantity at 25 pounds pressure being used for operating oil fires, while a smaller amount at 100 pounds pressure is used for sand rammers, enamel shakers, air hoists, pneumatic tools and appliances generally. Air at both of these pressures, 25 pounds and 100 pounds, is supplied from one compressor, which automatically proportions the amount of air delivered at each pressure. This compressor presents several novel features, among which are the following :—

(1) The compressor may be driven by either steam or electric power.

(2) The electric drive is by direct-connected motor, the rotor being directly on the crank shaft of the compressor.

(3) The steam drive is by cross-compound Corliss steam cylinders having high speed drop-release Corliss gear.

(4) The unloading device for stopping compression in the air cylinders is entirely novel in design and operation.

(5) The machine simultaneously delivers air at two different pressures, and automatically proportions the amount delivered at each pressure.

(6) The free air capacity of the machine may be increased by one-third without increasing the speed and by operating only one valve.

There are also other special features such as the flood lubrication system, the enclosed frames and the drag crank drive for the air gear.

The Motor for Driving.

The motor is of the induction type with wound rotor. The rotor is mounted directly on the compressor shaft. When running by steam the rotor acts as a fly-wheel and has sufficient fly-wheel effect to enable the machine to be run as slow as 25 per cent. of full load speed. The machine is made extra wide between the main frames to permit of moving the stator clear of the rotor to give access to the windings.

Steam Cylinders.

The steam cylinders are of the Corliss type, the high pressure clinder having drop-release gear and the low pressure cylinder having a quick-opening positive gear with fixed cut-off. Cylinders have separate steam and exhaust eccentrics. The steam receiver is located above the cylinders, where it is accessible, self-draining, easily insulated, and does not require a channel in the foundation. The air intercooler being located overhead in the same manner enables the foundation to be made practically a solid block of concrete.

Drag Crank Drive.

The Corliss air gear is driven by a drag crank on a short shaft driven from the crank pin. On the high pressure side this drag crank also forms the belt pulley which drives the governor. The drive from the crank pin is by a universal joint, so that any alteration in the position of the main shaft, due to adjustment of the bearings, does not affect the drive for the valve gear. The driving of the air gear by drag crank on the outside instead of by eccentrics on the shaft enables the air gear to be kept quite clear of the steam gear and readily accessible. The driving strains are also reduced by the larger permissible travel of the valve rods. Removing two eccentrics and a governor pulley from the shaft also permits the shaft to be shortened.

Unloading System.

The method of unloading consists briefly in opening a supplementary port in each Corliss inlet valve, thus letting the air pass out of the cylinder again instead of being compressed. Each of the Corliss inlet valves has within it a second Corliss valve of about half the diameter. The inner valve normally covers a supplementary port in the outer valve, and the two valves move together as one valve. In unloading, the inner valve is shifted to uncover this supplementary port and the air is then blown out again into the intake passage, instead of being compressed.

The mechanism for shifting the interior valve consists of a trip cylinder, shown in an inclined position in Fig. 3.

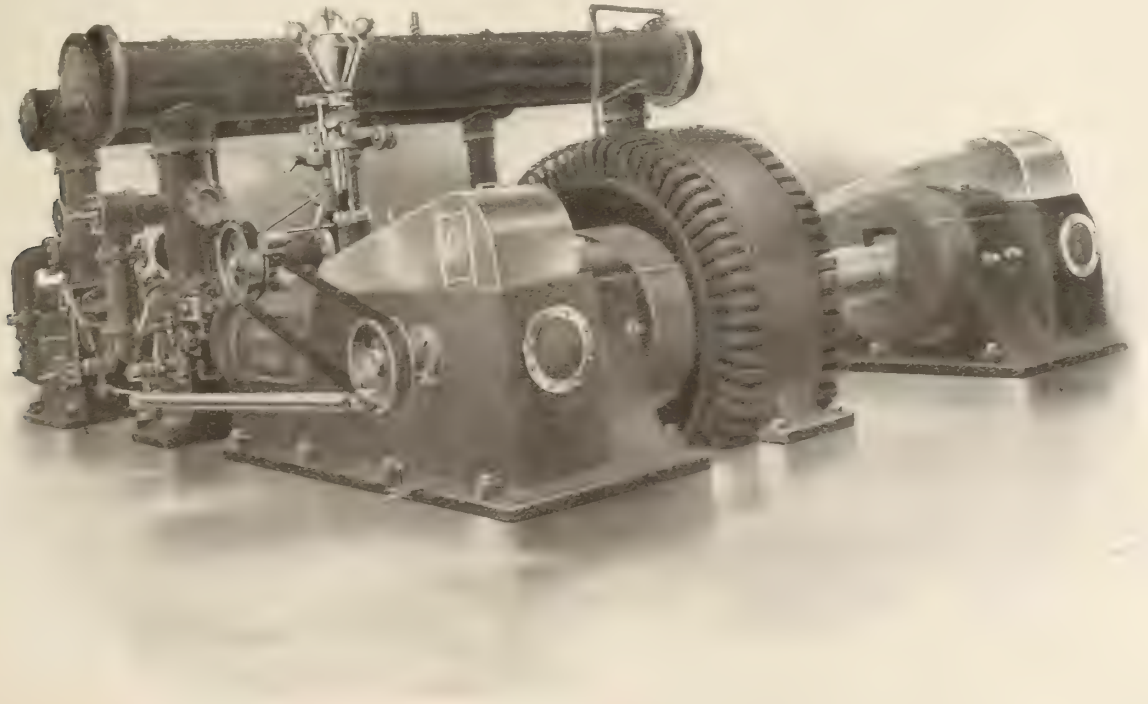


Fig. 1—Air Compressor installed in the works of the Standard Sanitary Co., Toronto, and made by the Canadian Rand Co., Sherbrooke.

Air to operate this trip cylinder is admitted or exhausted by the weighted operating valve, shown attached to the distance piece in the photo of the low pressure air cylinder. The operating valve is connected to the two trip cylinders by ¼-in. copper tubing, not shown in the photo. The connections from the operating valve are so arranged that one trip cylinder works before the other, thus unloading or loading each air cylinder in two stages.

Governor and Regulator.

The centrifugal element of the governor is of a familar type for Corliss engines, having a heavy central bob weight between the arms of the balls. If the speed becomes too high the centrifugal force of the revolving balls lifts the bob weight and, through the side link and bell crank, pulls on the long trip rod. This in turn shortens the cut-off in the high pressure steam cylinders. If the bob weight goes clear up to the collar, the steam valves will not be picked up at all and no steam will be admitted to the cylinder.

The action of the governor is modified by the air regulator. When air cylinders are unloaded air is also admitted to the small cylinder shown on the side of the governor. This lifts against the bob-weight so that the balls will lift the bob-weight at much slower speed. The machine accordingly slows down, but still remains under the control of the centrifugal governor. The result is that the machine slows down when the air cylinders are unloaded which is just the opposite of what it would naturally do. If there were no governor the machine would run away when the load was thrown off the air cylinders. If there were a governor only, the machine would speed up a few revolutions when the load was thrown off, but with governor and regulator the machine slows down when the load is thrown off.

For a machine to deliver air at one pressure only, the air regulator on the governor would be arranged to act somewhat differently.

The safety stop on the governor, to shut off steam in case of the governor belt breaking, deserves special note. A small heavy pulley is shown riding on the governor belt, and acting as a belt tightener. This is connected by levers and links to a cam located just below a roller on the near arm of the bell crank. The slotted links shown on the side of the governor post permit this arm to be raised independently of the governor. If the governor belt should break the tightener pulley would drop, the cam would shove up the short lever, the bell-crank would pull on the long trip rod, and the steam hooks would not pick up the valves. The result is that steam is shut off instantly. This device was tested at the power-house of the Standard Sanitary Co. with the above result.

Intercooler.

The intercooler is of the water-tube type, the air circulating around the tubes. This gives a large air space, making the fluctuations of air pressure in the intercooler very small. The air is directed by baffle plates to pass back and forth across the tubes, and as the tubes are staggered this causes the air to strike each tube at right-angles several times. The circulation is on the counter-current principle, that is the water enters at the end at which the air leaves, so that the coldest water is in contact with the air just before it leaves the intercooler. By this means the temperature of the air is reduced to within a few degrees of the temperature of the water supply, and may be actually lower than the temperature of the water overflow.

"TRIUMPH ORIGINALITY."

This is the title given to a bound volume of bulletins recently issued by the Triumph Ice Machine Co., Cincinnati, Ohio. No. 501 deals with the proper construction of a compressor; 502, vital points about the Younger Triumph

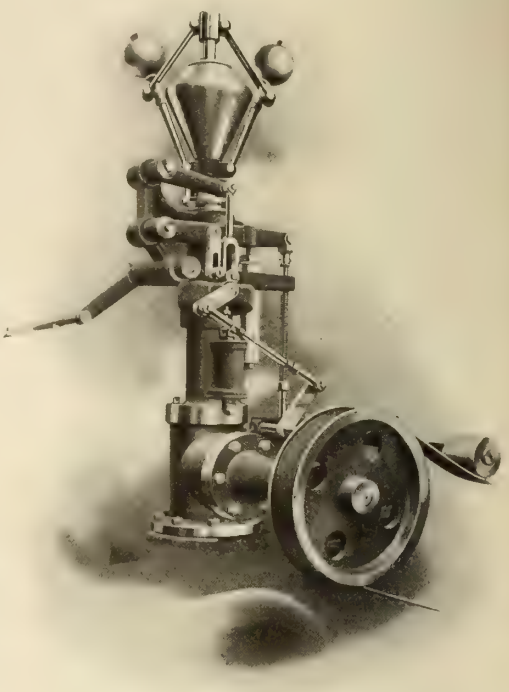


Fig. 4.—Governor of Rand Air Compressor

compressor; 503, the Triumph miniature compressor; 504, Triumph "Dog House" steam condenser; 505, the Triumph way of condensing ammonia; 506, making ice with Triumph equipment; 507, distilling water for ice making; 508, a profitable day load. These publications contain valuable information on refrigerating machinery, many tables being included of use to engineers interested in cold storage and refrigerating plants.

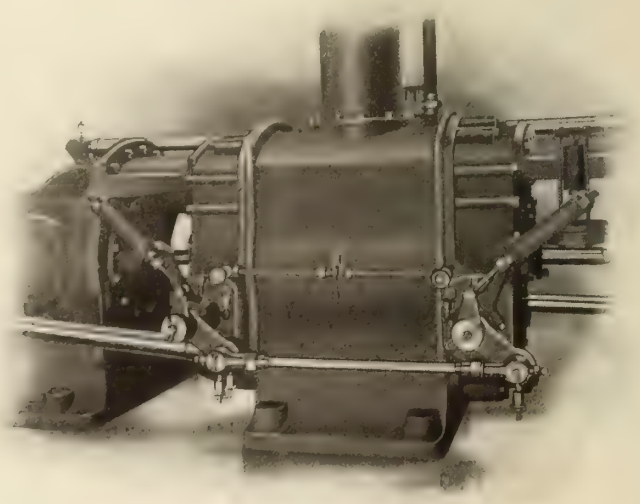


Fig. 3.—Unloading Device used on Rand Air Compressor.

TURBINE-DRIVEN BLOWER.

A 23 h.p. Terry Type A turbine has been installed in the works of the Provincial Steel Co., Cobourg, by the Standard Engineering Co., 47 Wellington St., East, Toronto. The turbine runs at 2750 r.p.m. and is belted to a No. 9 Aeolos fan, manufactured by Sheldon's, Ltd., Galt. The unit is operating at 125 lbs. steam pressure and atmosphere exhaust. It is very economical giving a horse power for every 40.75 lbs. of water.

The compactness of the turbine can be seen in the accompanying illustrations. Fig. 1 shows a 100 h.p. unit opened, and Fig. 2 shows a 150 h.p. unit. An advantage in favor of the turbine is the high rate of speed and small size.

Although there are many uses for which the turbine may be economically used. In the Cobourg installation it is used for running a fan, but in other plants it is used to drive generators, fire pumps, city supply pumps, boiler centrifugal pumps.

The Terry turbine is of the compound velocity stage impulse type, that is, the steam is practically wholly expanded in a correctly formed jet or nozzle, wherein its static pressure is converted into velocity energy. This energy is delivered to the wheel as useful work in the following manner :

The wheel is fitted with semi-circular buckets as shown in Fig. 1. The steam escaping from the jet strikes one side of this bucket, and is reversed in direction leaving the opposite side of the same bucket, then enters the first stationary bucket or reversing chamber. This chamber redirects the steam back again into another bucket of the same wheel at a point adjacent to the jet. This operation is repeated as many times as necessary for the complete utilization of all the available energy in the steam, its velocity being extracted successively in each reversal or stage.

As the flow of steam into and from the buckets is at all times in a plane normal to the shaft, there is, therefore, no end thrust regardless of initial pressure or vacuum, thus eliminating the chief source of trouble in steam turbines.

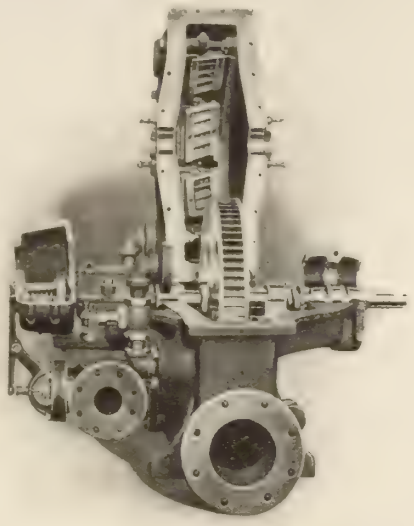


Fig. 1.—100 H.P. Terry Steam Turbine, Opened.

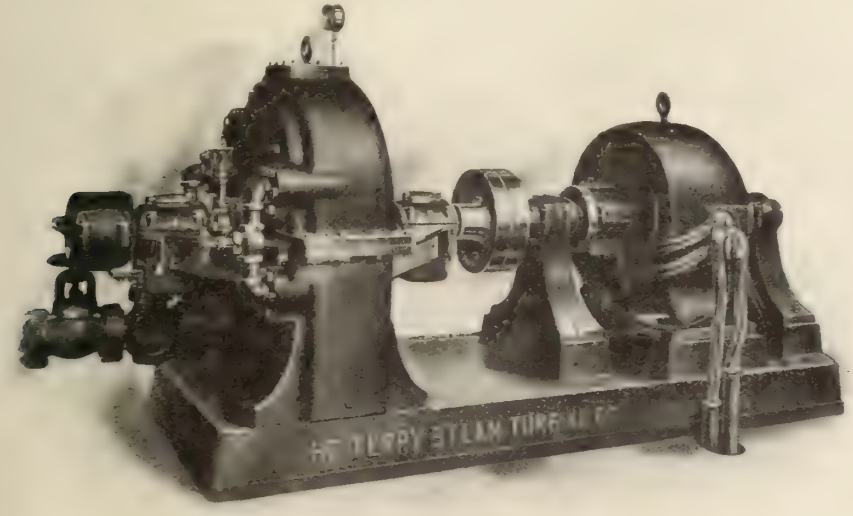


Fig. 2—Terry Turbine and Generator.

Increased power for a wheel of a given diameter is obtained by fitting additional jets and reversing chambers in the casing, each jet of course, being supplied with live steam. When partial load is to be carried at times, one or more of these jets may be turned off by hand operated valves to give full load efficiency.

The casing and bearings are parted horizontally, so that by lifting the covers the entire turbine is open for inspection.

The governor is of the fly ball type, mounted directly on the turbine shaft, and controls a specially constructed mitre throttle valve. As no gearing is employed the necessity of an emergency governor is so slight that none is fitted in the standard design. Furthermore, should the main governor spring break the governor valve would instantly close. A maximum speed variation of 2 p.c. is guaranteed when desired.

Low pressure turbines to utilize the exhaust steam from non-condensing engines, may be effectively installed. As the energy in steam expanded from atmospheric pressure to 28 inches is almost equal to that in the same steam expanding from 150 pounds to atmosphere, the saving in fuel resulting from using exhaust steam by means of a turbine, with a condenser for low vacuum is apparent.

The Terry turbines are manufactured by the Terry Steam Turbine Co., 90 West St., New York, for whom the Standard Engineering Co., 47 Wellington St. East, are Canadian agents.

Improvements and changes are to be made to the waterworks at Carleton Place, Ont.

The ratepayers of Vancouver, will be asked to authorize the expenditure of $500,000 on sewer extension work.

Many a man longs for more authority —and finds, after he gets it, that he was really happier when he had less responsibility.—Ex.

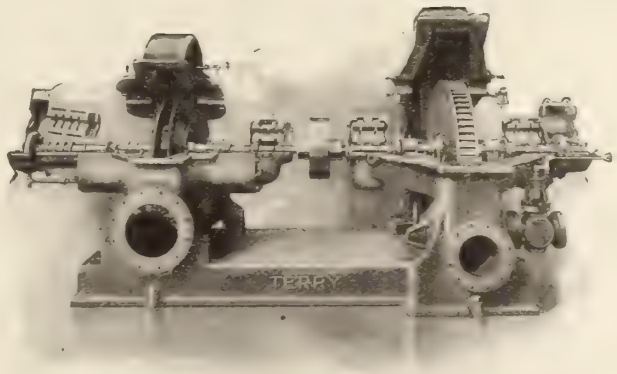


Fig. 3.—Terry Turbine Direct Connected to Turbine Pump.

Power Plant Developments.

BRITISH COLUMBIA.

VANCOUVER—The Lake Bank Creamery Co. is installing a 10 ton refrigerating plant with small ice making system. Machinery is being supplied by the Armstrong Machinery Co., Spokane, Wash.

VANCOUVER—The Astor Hotel, E. Pearson, manager, is to be equipped with a 5-ton "Alaskan" refrigerating plant, contract for which was let to the Armstrong Machinery Co., Spokane, Wash.

ALBERNI—The Alberni District Electric Light & Power Co. has been incorporated. Capital, $2,500. Electricity will be generated by a steam plant.

VANCOUVER—The Canadian General Electric Co. were awarded the contract for supplying 2,000 Tungsten lamps for the Granville standards at $1.25 per light.

ALBERTA.

CALGARY—Campbell & Hamilton have erected a cold storage warehouse and will install a 35-ton "York" refrigerating plant, contract for which was let to the Kent Co., Ltd., Montreal.

EDMONTON—The council is discussing a proposition to erect a plant at Rocky Rapids, on the Saskatchewan river.

CALGARY—The city commissioners have recommended the accepting of tenders for about two hundred lamps of the same pattern as adopted in Toronto. Five globes are on each lamp post and the iron work is arranged very ornamentally. The Canadian Equipment Co. and the Canada Foundry Co. are the successful tenderers. The total cost will be $11,400. Each company will supply half the number of lamps.

SASKATCHEWAN.

SASKATOON—The city will spend $60,000 on additions to the electrical plant.

ROULEAU—Tenders addressed to W. H. Stewart, secy.-treas., will be received until April 4th for the following: Electrical machinery, pole line, etc.; pumping machinery, compressed air system; producer gas plant. Also mains, c.i. or steel water mains, tested to 300 lbs. hydrostatic pressure; c.i. water main, tested to 300 lbs. hydrostatic pressure; 1,000 feet 4-in. c.i. water mains, tested to 300 lbs. hydrostatic pressure; special castings, tees, etc. Also valves, hydrants, valves, etc., as follows: 22 6-in. hydrants, etc., 47 6-in. left-handed gate valves; 47 6-in. valve boxes, extending 7 to 8 feet. Plans, etc., at office of the above or at office of J. Darlington Whitmore, consulting engineer, 104 Willoughby and Duncan block, Regina, Sask.

MOOSE JAW—Sealed tenders, endorsed "Tender A" and "Tender B," will be received by W. F. Heal, city clerk, until Monday, April 10th, 1911, for supplying material for and constructing a sewage disposal plant complete, including pump house, sedimentation tanks and percolating filter, also the supply of materials for and the laying of a trunk sewer and water main. Also supplying two electrically-driven centrifugal pumps and auto starters complete with all piping, connections, etc.

SASKATOON—Tenders addressed to Jas. Clinskill and W. B. Neil, city commissioners, will be received until March 27th for supply of the following: A 150 kw. 2,200 volts, 60 cycle, 120 r.p.m., 2 phase generator, exciter, installed complete. Alternative tenders for the above are asked for in three phase (B) 1,250 h.p., 120 r.p.m., vertical cross compound Corliss engine, with condensing apparatus and feed water heaters, installed complete. C direct connected exciter engine to run exciter for 750 kw. generator, installed complete; (D) one steel smoke stack, with a height of 100 feet, and inside diameter of 80 inches with connections, etc.

ONTARIO.

PETERBORO—The C. G. E. intend erecting a lamp factory here, 60x250 feet. Cost, $250,000.

HAMILTON—Goldie & McCulloch, Galt, have been awarded the contract for five boilers for the pumping plant at Hamilton Beach.

STURGEON FALLS—The city is proposing to develop 300 h.p. on the Sturgeon river.

OTTAWA—A sewage disposal plan is being discussed by the Board of Control.

WELLAND—The Welland water commission has secured from the Canadian Minister of Railways and Canals water rights on the Welland canal. The commissioners are planning a new plant. The plans provide for a 30-foot intake and a capacity of 3,000,000 gallons a day, and facilities for doubling this economically. There will be a power intake and waterworks intake. The power house will have two water wheels, an electric apparatus, etc., while the pumping station will have a modern pumping equipment.

CHAPLEAU—Sealed tenders will be received by T. J. Godfrey, town clerk, until 8 p.m. on Monday, March 27th, 1911, for furnishing and erecting Duplex steam pumping engine, with a capacity of 800 gallons per minute, and one return tubular boiler.

COBALT—The Northern Ontario Light & Power Co. has received a charter. Capital, $7,500,000. It is expected the Cobalt and Haileybury power companies are included in the above company.

PORT ARTHUR—The capacity of the Kaministiquia Power Co.'s power plant is to be doubled. $250,000 will be spent.

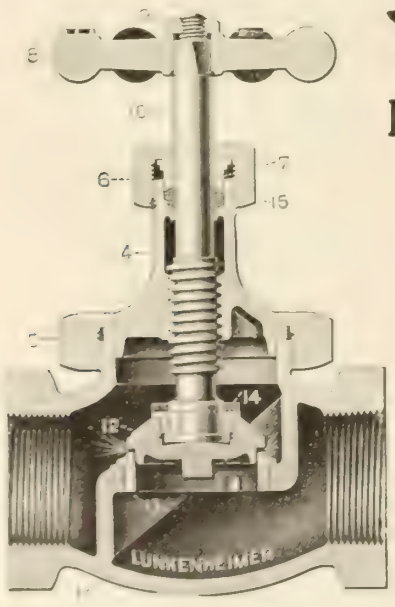
TORONTO—The sum of $113,000 will be spent on waterworks this year. Included in this amount are: New boilers for the Beach plant, $6,000; deepening well at Beach, $1,000; to complete new shops, $4,000; new services, $30,000, and new water mains, $36,832.

QUEBEC.

MONTREAL—A contract has recently been let for the installation of an electrical power plant for the Union Bag & Paper Co., Three Rivers, Que. Ralph D. Mershon & Co. are the engineers in charge of the work.

NOVA SCOTIA.

SYDNEY—The ammonia plant of the Dominion Steel Corporation is about completed and will turn out 27 tons per day. This output will be doubled when the complete plan is carried out.



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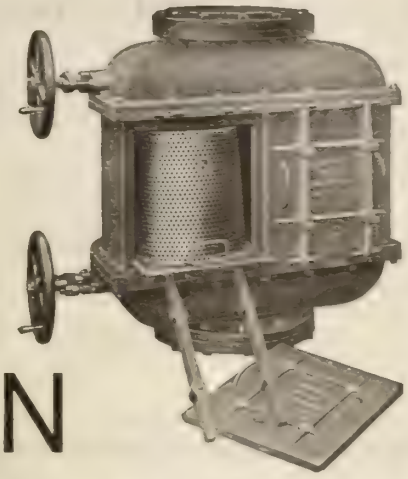

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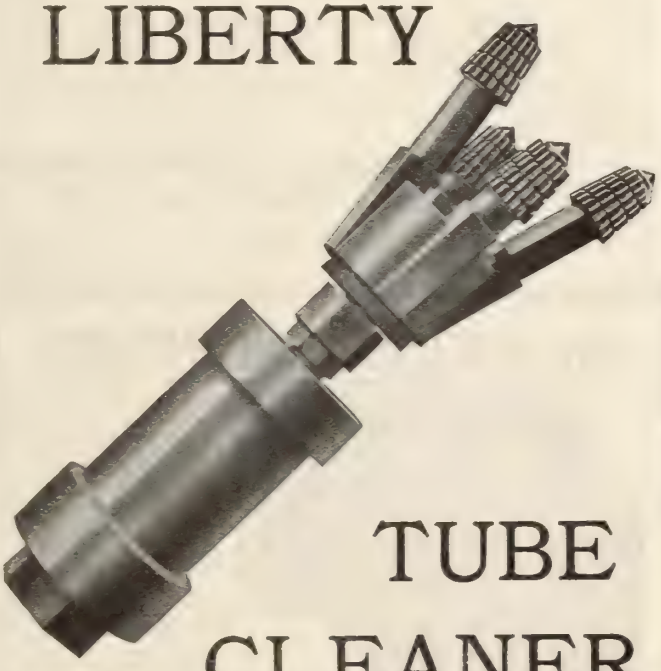

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is the best means of overcoming this condition, removing the scale and saving your boiler from the danger of burned out tubes which is much greater when they are thickened by scale. This Cleaner is operated by air, steam or water.

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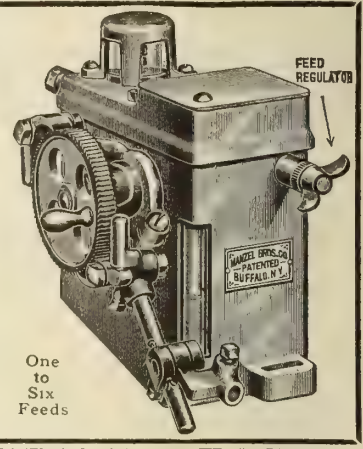

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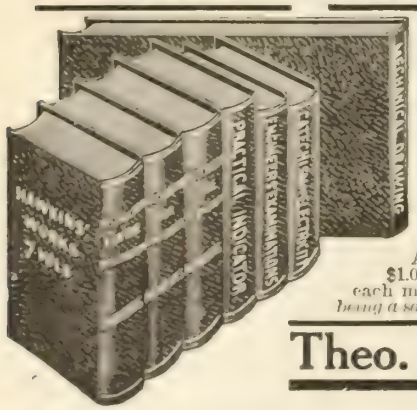

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PROPER CARE OF BELTS—24 page booklet from the Joseph Dixon Crucible Co., Jersey City, N.J., giving general information on belts, belt dressings, hints, kinks and tables.

TURBO-PUMPS—The Canadian Boving Co., 164 Bay street, Toronto, have issued a catalogue on Victoria turbo-pumps. This catalogue contains some excellent data and information on pumps which makes the catalogue a valuable one.

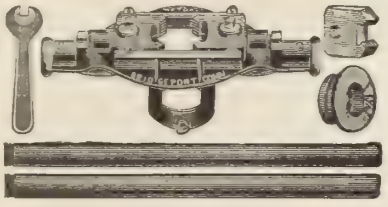
SOME FRICTION TESTS—44 pages, 5x7 in. booklet issued by the Quaker City Rubber Co., Philadelphia, describing what friction means, waste due to friction and tests with different packings.

WEBER GAS ENGINES—Catalogue No. 22, twenty pages 8x17 ins., gives particulars of the heavy duty gas engines manufactured by the Canada Gas Producer and Gas Engine Co., Barrie, Ont

THE RICHARDSON-PHOENIX CO.

The Richardson-Phenix Co., Milwaukee, Wis., a consolidation of the Sight Feed Oil Pump Co. of Milwaukee and the Phenix Lubricator Co. of Chicago, has completed the equipment of its new factory in Milwaukee, which it claims is the largest plant in the country devoted exclusively to the manufacture of lubricating devices. The new company will manufacture the well-known Richardson and Phenix mechanical lubricators, individual oiling systems, power plant oil filters, and general appliances for lubrication, for cylinder lubrication and also for machinery.

Wilbur E. Richardson, president of the company, has devoted a number of years to the development of this business, which has grown so rapidly that it has been found necessary to broaden the organization in order to handle the largely increased business. He is in personal charge of the works and will continue to devote his time to designing and developing new apparatus for efficient lubrication. J. Wm. Peterson, president of the Peterson Engineering Co., lubrication engineer, New York City, has been appointed general manager of sales, with headquarters in the Hudson Terminal Building, New York City. He has for several years been engaged in the design and installation of power plant oiling systems. The Western sales office is located in the First National Bank Building, Chicago, and will be under the management of J. S. Ward, who for several years was identified with the Phenix Lubricator Co. The Eastern and Western sales offices have been augmented by sales representatives in various cities throughout the country. A new series of interesting engineering bulletins, bearing on the subject of lubrication, is being prepared, and engineers desirous of receiving the series can have their names placed an the mailing list by communicating with either office mentioned above.



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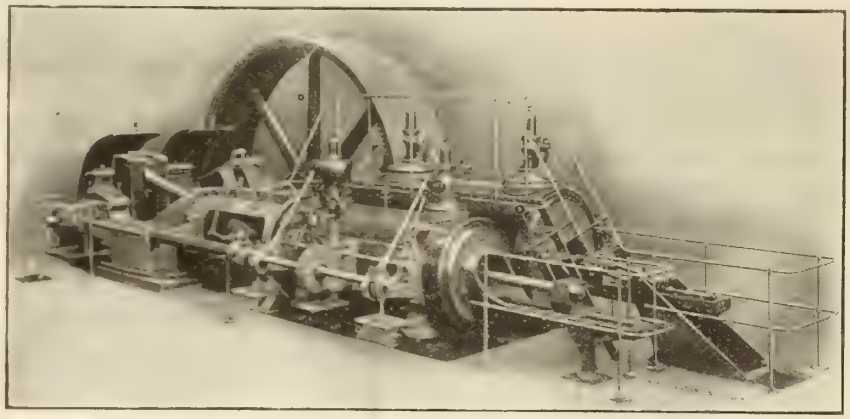

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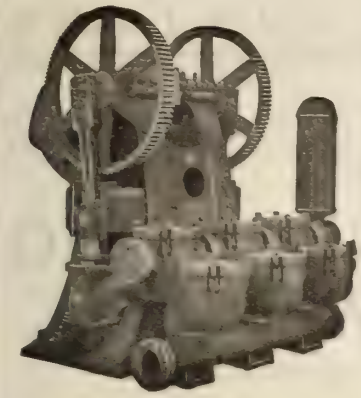

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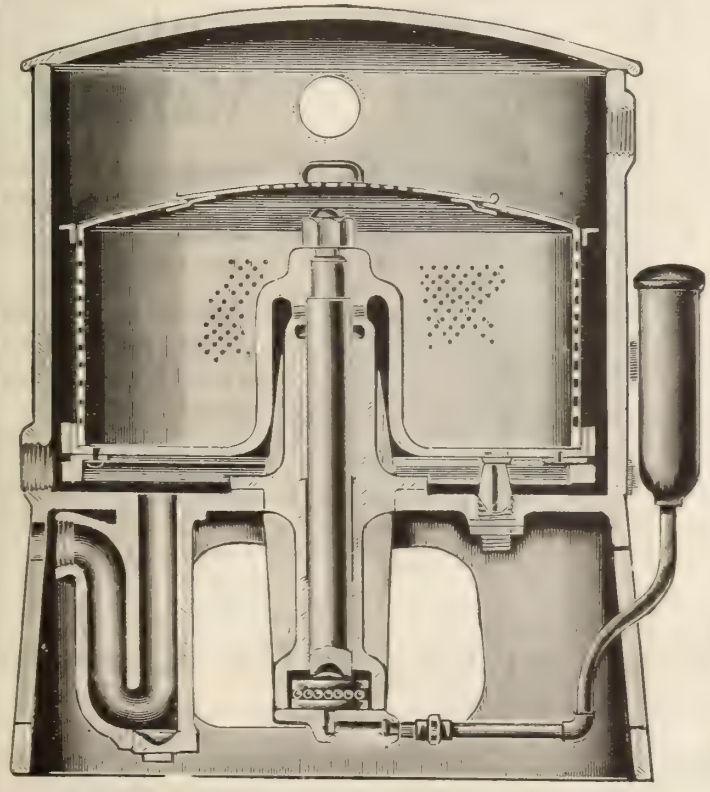

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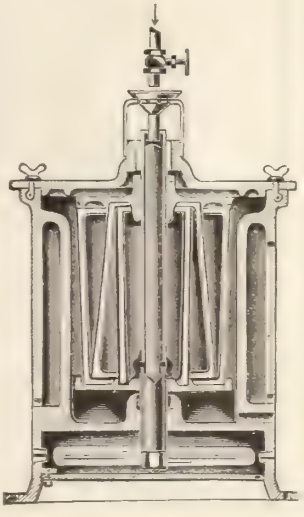

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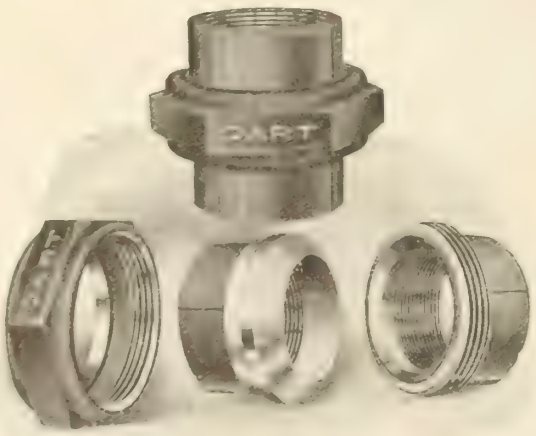

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When your blow-off valve leaks, your loss is proportionate to the size of the leak. We guarantee that the

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Give us a chance to prove it.

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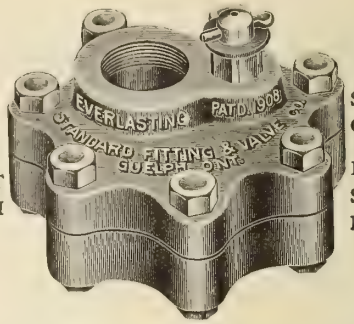

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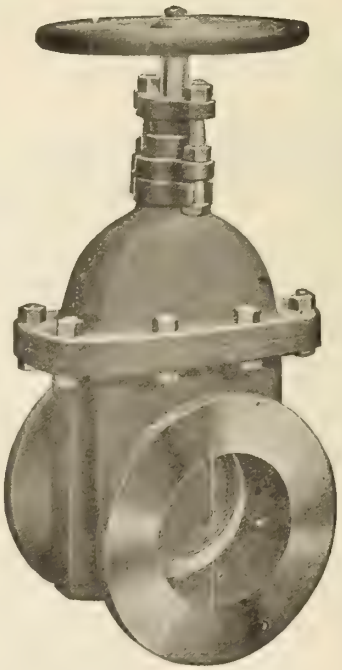

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The Metal suitable for all classes of machinery

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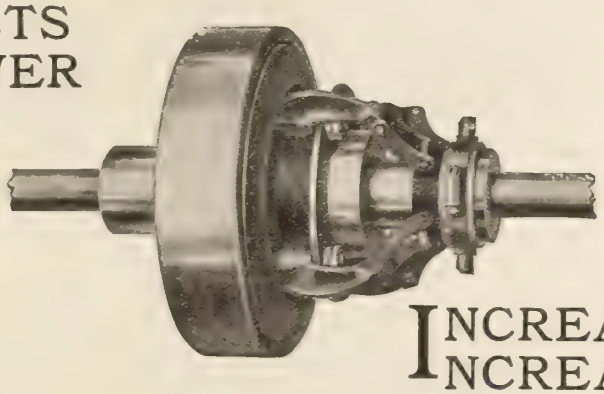

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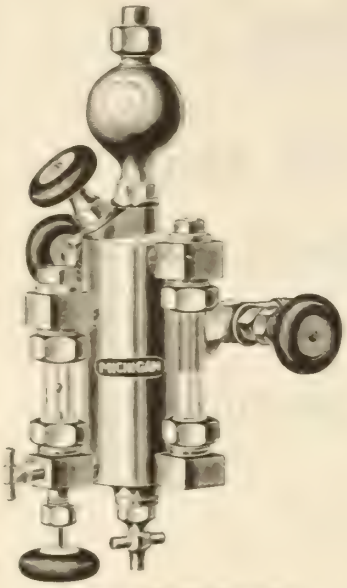

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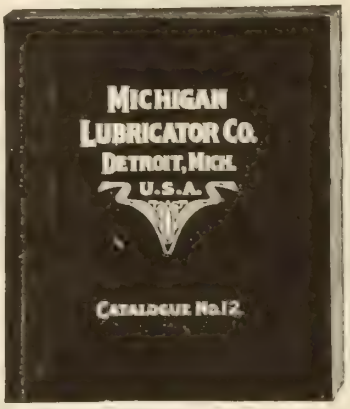

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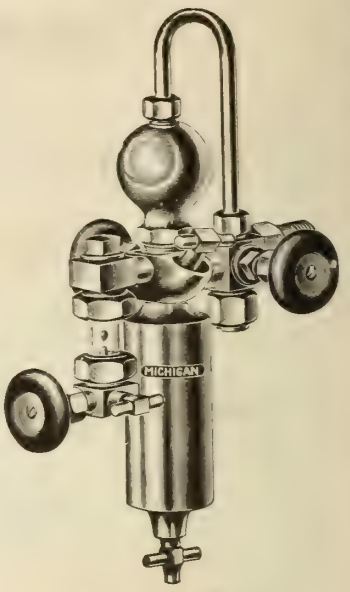

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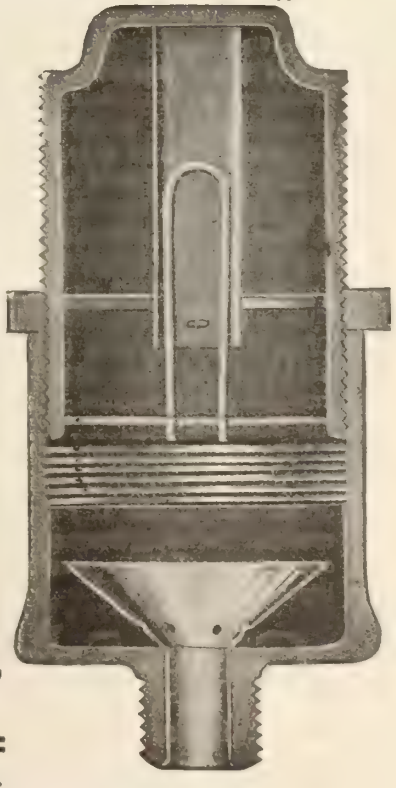

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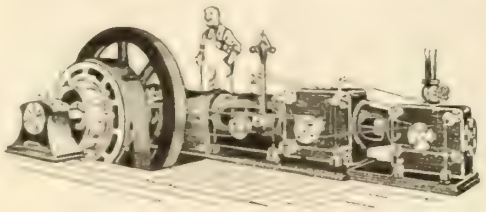

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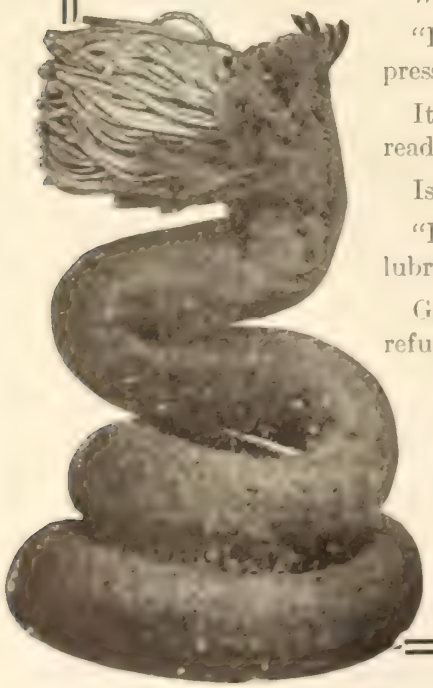

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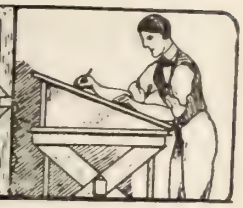

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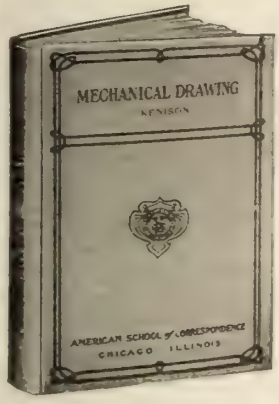

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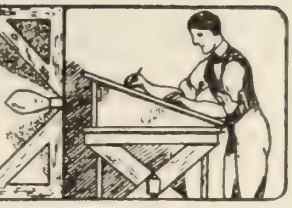

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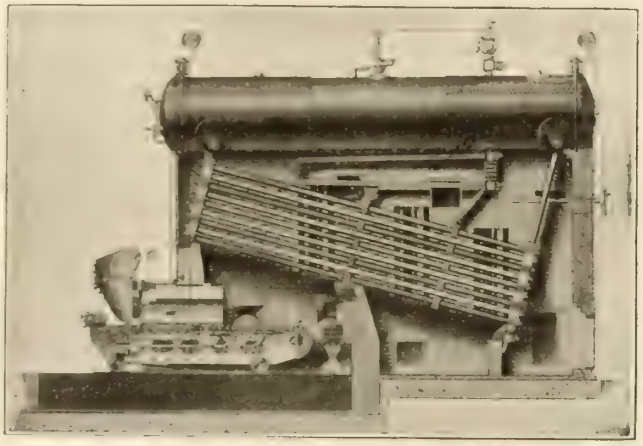

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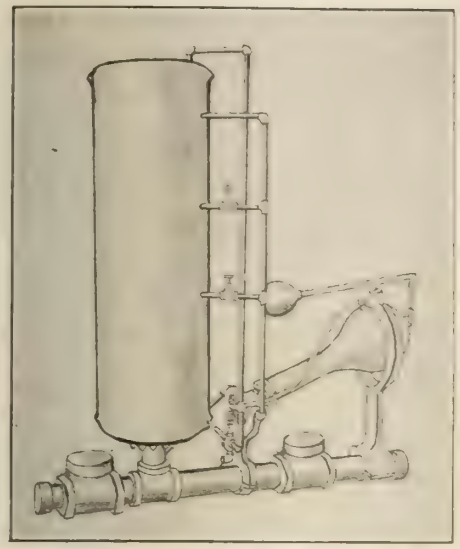

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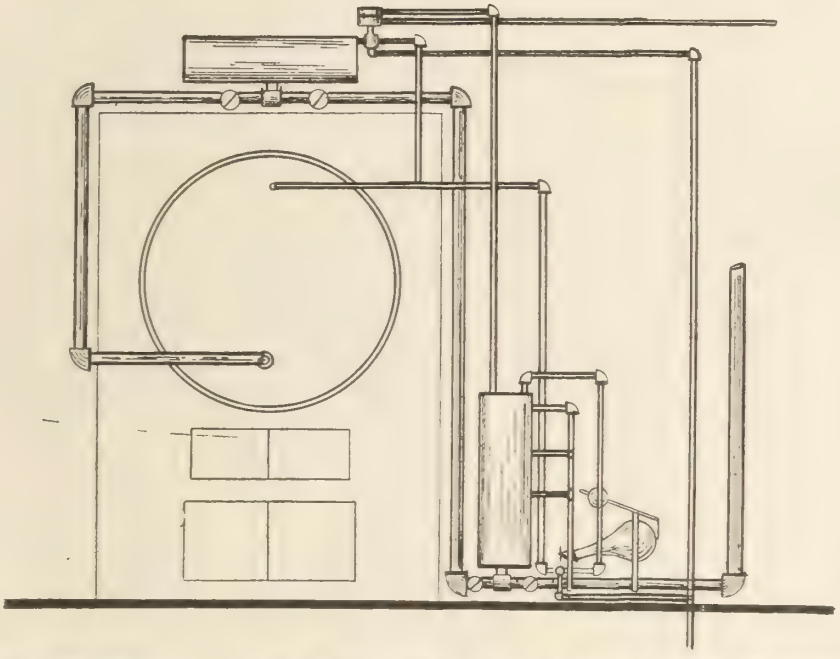

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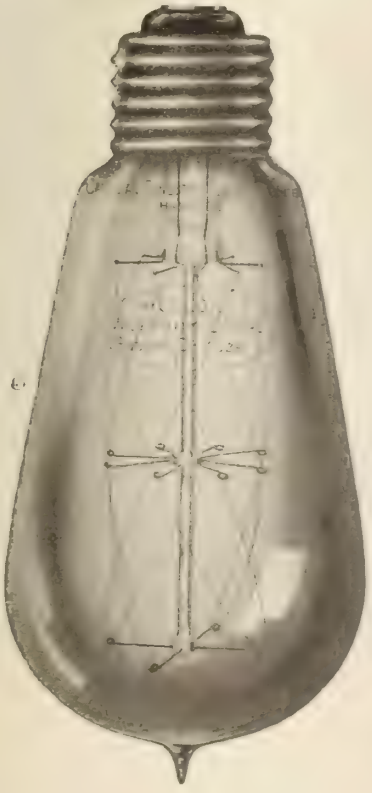

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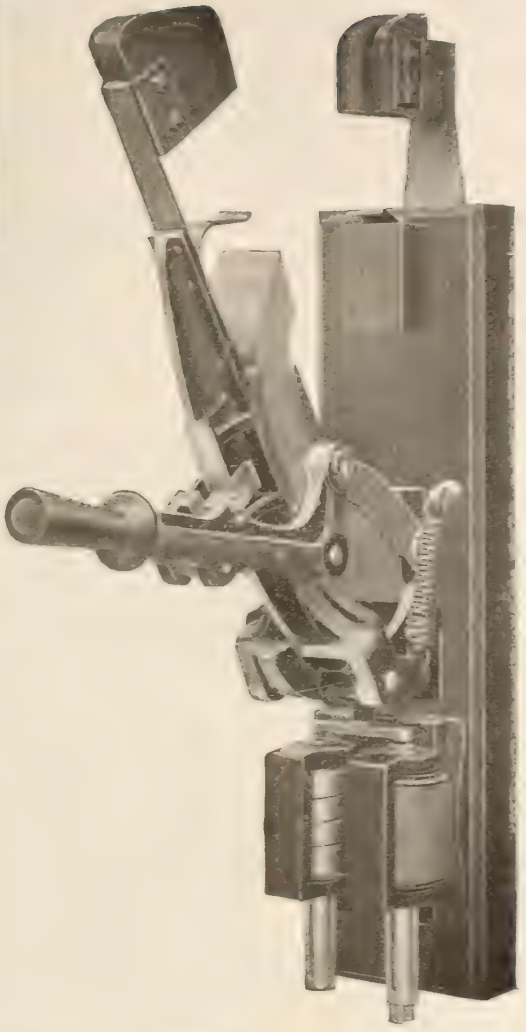

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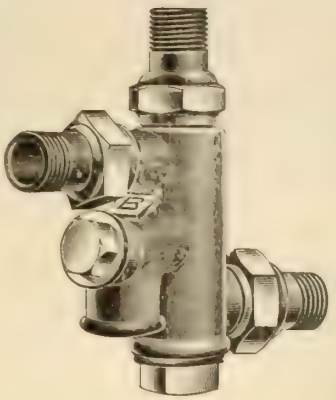

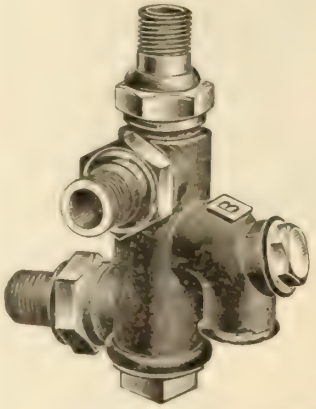

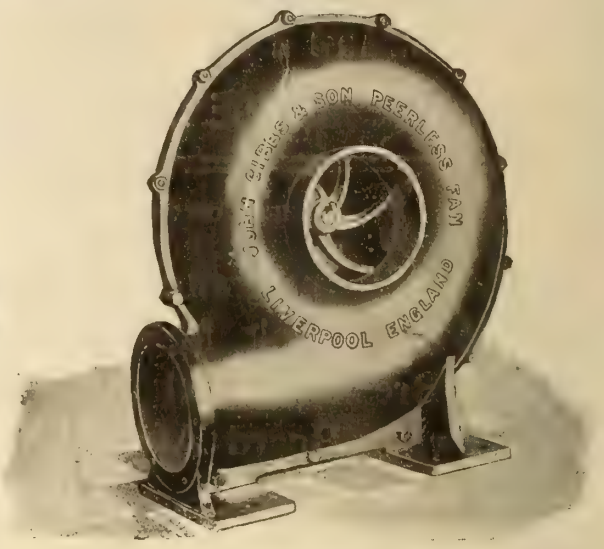

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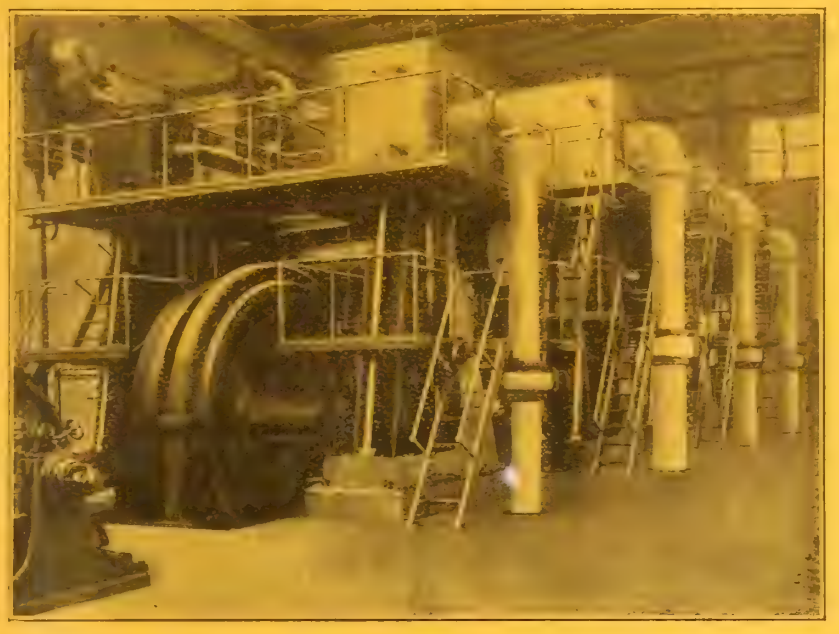

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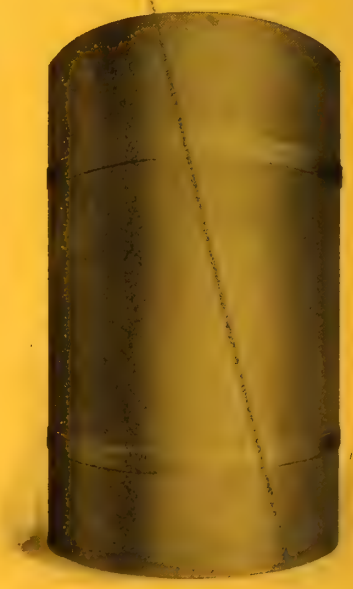

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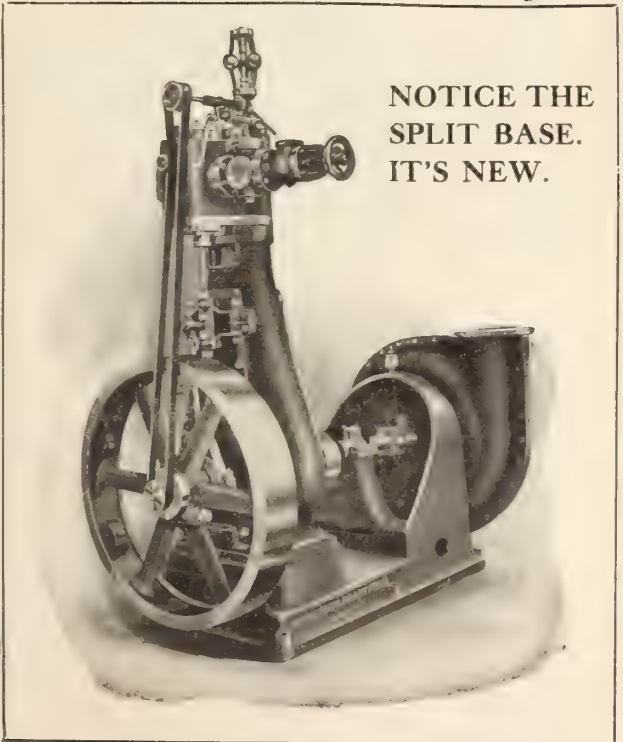

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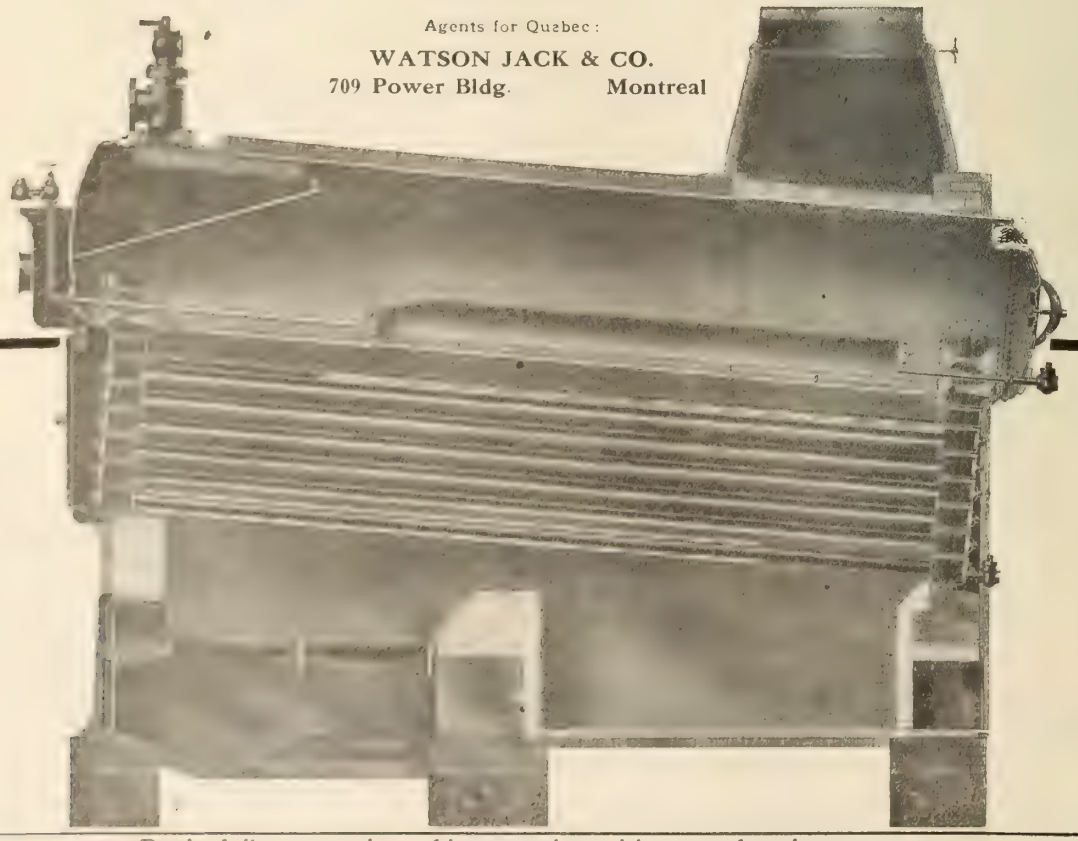

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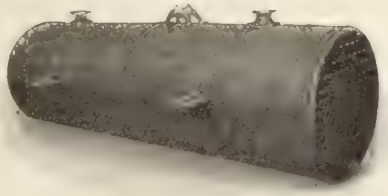

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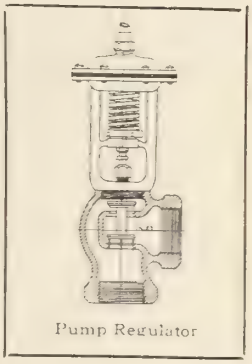
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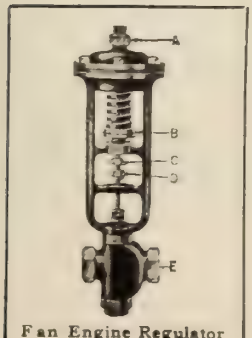
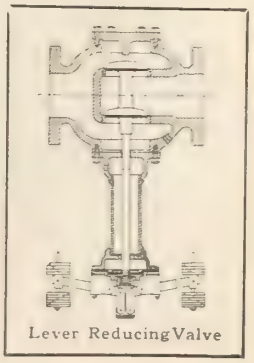
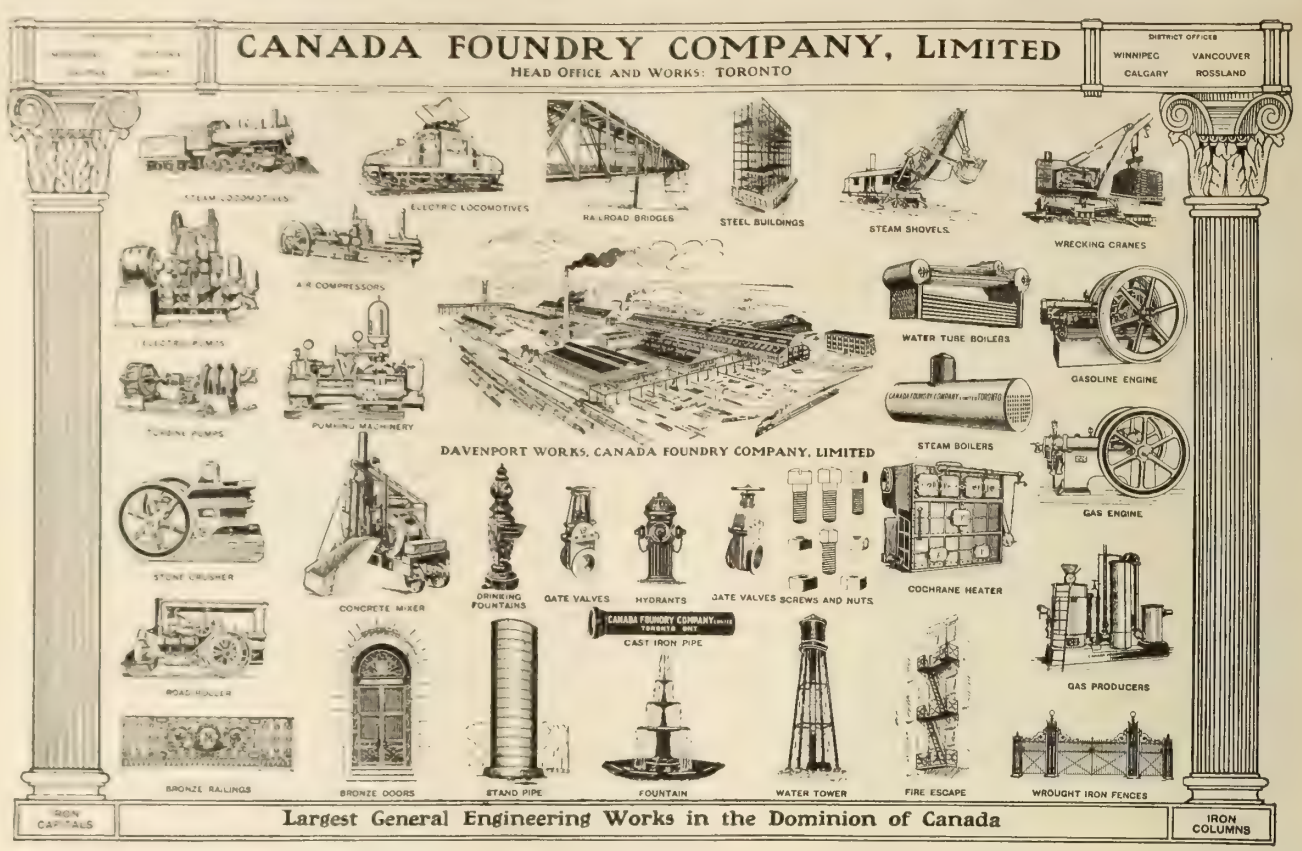
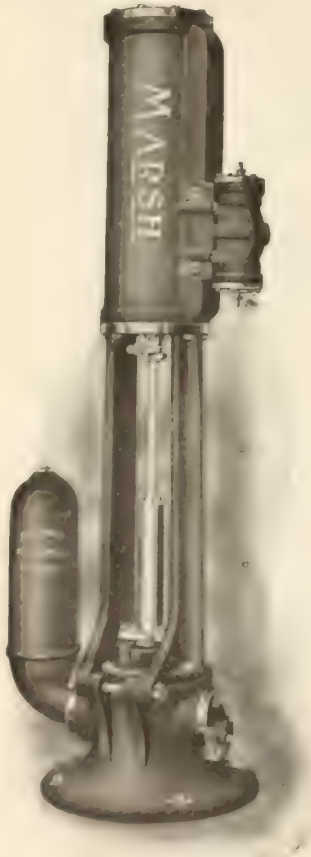
Power Economies, Limited
9 St. Nicholas Street, Montreal



Fan Engine Regulator


Lever Reducing Valve





DEEP WELL PUMPING

Are you sure that you are obtaining the maximum capacity from your well with a minimum steam consumption?

The distinguishing feature of Marsh Deep Well Pumps is high efficiency combined with low cost of up-keep. They are equipped with a self-governing steam valve which admits just enough steam to do the required work. They are made with hinge base, affording easy access to the well pipe at all times.

AIR LIFT SYSTEMS

We also manufacture a line of steam and power driven air compressors which combine durability with highest efficiency. The Marsh Steam Valve is especially adapted for air compressor service.

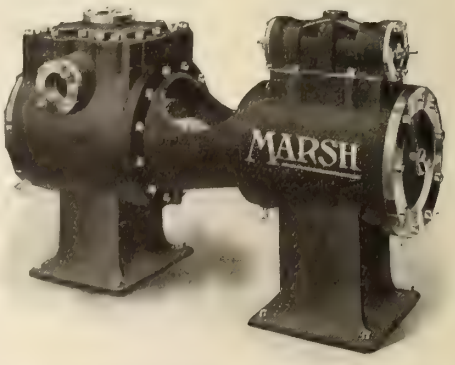
Ask for our No. 18 catalog.

American Steam Pump Co.

BATTLE CREEK, MICH.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto
Williams & Wilson, Montreal.
Stuart Machinery Co., Winnipeg.
Gorman, Clancey & Grindley, Limited, Edmonton and Calgary
Hallman & Peniston Machinery Co., Vancouver, B.C.
London Engine Supplies Co., London, Ont.
Mechanics' Supply Co., Quebec, Que.
Jenckes Machine Co., Sherbrooke, Que.



No.

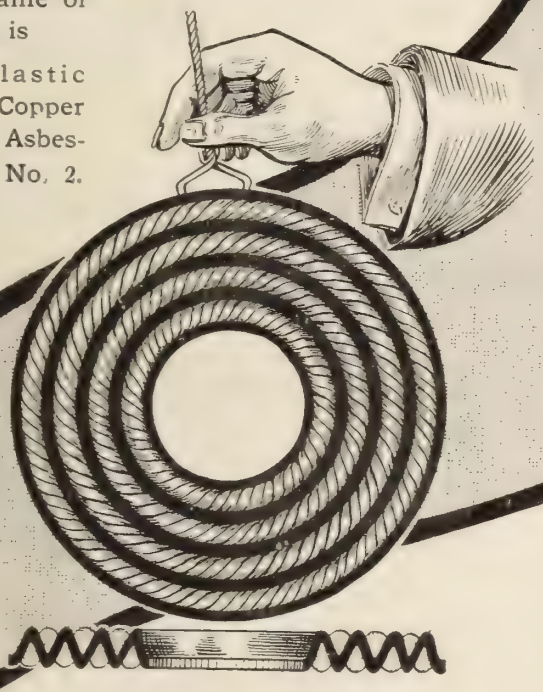
Just Say:
"Goetze's No. 2 Gaskets"

and you'll get the right thing, if your idea of the "right thing" is a gasket that will make **positively and permanently tight joints** in flanged piping. And this means tight joints in spite of the **highest** of **pressures** or **temperatures**—even **highly superheated** or **saturated** steam and in **long lines.**

The full name of these Gaskets is

Goetze's Elastic Corrugated Copper Gaskets, with Asbestos Lining, No. 2.

If in a hurry, send your order by "Night Letter" at OUR expense.



We'll send you a supply of Goetze's No. 2 Gaskets on 90 days' trial at OUR risk.

But you don't have to say, or write, all that in ordering. Save your time by writing simply "Goetze's No. 2 Gaskets" and you will get what you want and get it promptly. Simply give us the sizes you want, and the number of each size, and unless you specify something "special," we will ship them within **30 minutes** on receipt of your order.

A minute's study of the above cut will show you that "Goetze's No. 2" is put together to stop leaks "for keeps," and the minute you hold one of them in your hand you'll **know** that it will do the work. Send your trial order to-day—now. We take all the risk. Ask for our Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

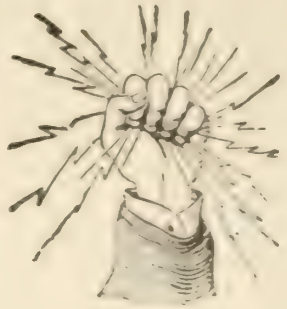
T. McAvity & Sons, Limited, St. John, N.B.

Branches at MONTREAL 163 Esplanade Ave. TORONTO 404 McKinnon Bldg. WINNIPEG Box 331 VANCOUVER care A. O. Campbell

American Goetze-Gasket & Packing Co.
New Brunswick, N.J.

The advertiser would like to know where you saw his advertisement—tell him.

PHILLIPS

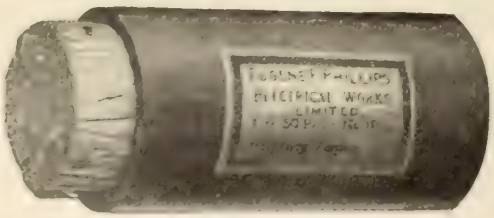


Bare and Insulated Copper

WIRES AND CABLES

FOR

Telephone, Telegraph, Lighting, Power and Street Railway Equipment



Rubber Covered Wires and Cables
Railway, Feeder and Trolley Wire
Incandescent and Flexible Cords
Weatherproof Magnet Wires and Cables
Bare and Insulated Electric Wires, and
Cables for Aerial and Underground use

Write us for quotations on your requirements

Eugene F. Phillips Electrical Works, Limited

MONTREAL : : CANADA

Branches—HALIFAX, TORONTO, WINNIPEG and VANCOUVER

The Transmission

of information and orders by

Northern Electric

INTER-PHONES

is instantaneous, and you don't have to wait for an answer.

The EFFICIENCY of your force is increased materially

AND

The OPERATING COST is necessarily reduced.

THE ENTIRE BUSINESS AT YOUR FINGER-ENDS.

The "SUPERINTENDENT'S CALL SYSTEM"
A special service system whereby a signal can be sent for any one wanted to every phone in the system.

They Save Time and Steps

An Inter-Phone System for every special or exacting condition.

WRITE DEPARTMENT No. 992

THE Northern Electric
AND MANUFACTURING CO. LIMITED

MONTREAL TORONTO WINNIPEG REGINA
CALGARY VANCOUVER

The advertiser would like to know where you saw his advertisement—tell him.

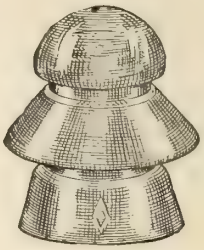
THESE TRADE
ESTABLISHED STA

RUBBER COVERED · TRADE ADANAC MARK · WIRES AND CABLES

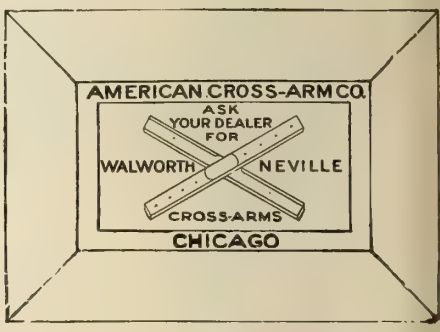
THE WIRE & CABLE COMPANY

MADE IN TRADE DUNCAN MARK CANADA

DUNCAN SOCKETS AND CUTOUTS



DIAMOND GLASS INSULATORS



DRY BATTERIES

TRADE MARK

"Chloride Accumulator"

REGISTERED SEPTEMBER 11, 1894

"Exide"

STORAGE BATTERY

HUBBELL

HUBBELL SPECIALTIES

ARROW ELECTRIC SWITCHES

QUALITY

Each Trade-Mark is Your Guarantee of Quality and Economy

TRADE FARADAY MARK

SKELETON AND ENCLOSED SIGNAL BELLS

BRYANT

SUPERIOR WIRING DEVICES

(Reg. U. S. Pat. Off.)

CONDUITS COMPANY LIMITED · TORONTO, CANADA ·

LORICATED AND GALVADUCT CONDUIT

"COLUMBIA"

METAL PANEL AND CUTOUT BOXES

FIRE ALARMS · THE NORTHERN ELECTRIC AND MFG. CO. LIMITED · TELEPHONES SUPPLIES

THE Northern

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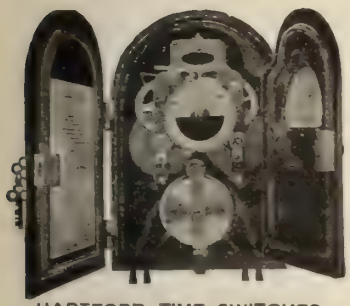


HARTFORD TIME SWITCHES

BROOKFIELD

1872 EDWARDS

EDWARDS & CO. HOUSE GOODS

WEATHERPROOF TRADE WACCO MARK WIRES AND CABLES

THE WIRE & CABLE COMPANY

WARD LEONARD

RHEOSTATS AND CONTROLLERS

D & W

D. & W. FUSES AND CUTOUTS

TRADE P & B MARK

P. & B. INSULATING COMPOUNDS

CH

CROUSE-HINDS CONDULETS AND PANEL BOARDS

IMPROVED BLUE BELL BATTERY

SERVICE

The Large Assorted Stocks in Our Houses, Allow Immediate Shipment on all Standard Material

Inter-phones

UNGST DAYLIGHT OLIER

MAZDA LIGHTING FIXTURES

THOMAS QUALITY RELIABILITY

THOMAS INSULATOR

PERKINS SUPERIOR WIRING DEVICES

(Reg. U. S. Pat. Off.)

Electric

URING CO. LIMITED

FIRE ALARMS THE NORTHERN ELECTRIC AND MFG. CO. LIMITED TELEPHONES SUPPLIES

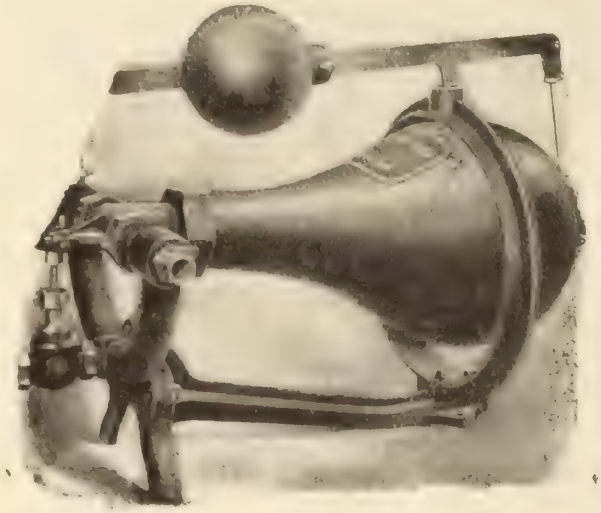
AREST HOUSE **REGINA CALGARY VANCOUVER**

236

The advertiser would like to know where you saw his advertisement—tell him.

133 BUNDY TRAPS—

Aggregating in value over $12,000—sold in Eastern Canada in September, October, November and December, 1910.



WHY? Here is the Reason.

The Saving to Purchasers of these 133 Traps in Fuel alone---not including increased efficiency ---will be over $18,000 during 1911. This is not supposition---it is our guarantee, based on performances in many factories in Canada, and this will be exceeded.

Are you obtaining maximum efficiency at minimum fuel cost?

Are you interested in reducing running expenses and production cost at the boiler end?

We are Specialists in this Line, and our Pamphlet "The Saving of Heat Units," and Catalogues, are gladly mailed on request.

We also sell the following Reliable **ENGINEERING Specialties**

BUNDY RETURN TRAPS.
BUNDY TANK TRAPS.
BUNDY STEAM SEPARATORS.
BUNDY OIL SEPARATORS.
MASON REDUCING VALVES.
MASON PUMP REGULATORS.
MASON DAMPER REGULATORS.
MASON BALANCED VALVES.
BERRY FEED CONTROL.
REILLY MULTICOIL HEATERS.
FRANCE METALLIC PACKING.
"PBH" GAUGE COCKS.
"PBH" TRY COCKS.
TORNADO FLUE CLEANERS.
ASHTON POP VALVES.
ASHTON RELIEF VALVES.
ASHTON ALARM GAUGES.
ASHTON PRESSURE GAUGES.
ASHTON VACUUM GAUGES.
REILLY MULTIPLE EVAPORATORS.

H. L. Peiler & Company

52 St. James St., Montreal :: 404 McKinnon Bldg., Toronto

Maritime Branch: Macleod Bldg., Moncton, N.B.

Western Agents:

W. E. Skinner, Ltd., 518 Somerset Bldg., Winnipeg

THE GARLOCK

CATALOGUE will assist YOU in solving your engine room troubles. Ask for it to-day.

Works at Hamilton, Canada

Sole Manufacturers of

Garlock Packings

in low and high pressures. For steam, hot and cold water, ammonia, gas, air and liquids.

RUBBER VALVES, DIAPHRAGMS

ASBESTOS
PAPER, MILLBOARD and CEMENT

MINERAL WOOL
PIPE COVERINGS

The Garlock Packing Co.

Toronto HAMILTON Montreal

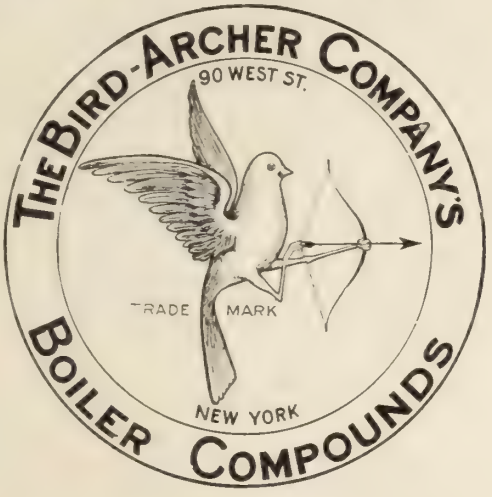
Pioneers in the Packing Business.

Don't fail to mention this paper in writing to advertisers.

It Certainly Is Hard To Decide Which Boiler Compound Is Best

NOT which is best for somebody else, but which will most surely meet the conditions that confront *you*.

Of course, they're all "best" on paper. But how to *know*, without a lot of costly experimenting and, perhaps, risk to your boilers, just which of them you need—that is the big question.



We're old in this business. We know the experiences and disappointments that many of you have had. We can see the whole situation from *your* viewpoint as well as from our own. So we long ago worked out a sales plan that, first of all, protects you from any possibility of loss through the use of Bird-Archer Boiler Compounds. In the first place

Bird-Archer Boiler Compounds Are Guaranteed Fully and Unqualifiedly to Do the Work

for which they are supplied, without the slightest injury to your boilers. Our guarantee is not merely a conglomeration of high-sounding phrases that mean nothing when boiled down to net. It is a *definite* Guarantee—a Guarantee that protects *you*.

Now, in order to protect *ourselves* against loss under that Guarantee, we've got to be *sure* that the Bird-Archer Compound we send you will do the work you want done, and do it so surely that you will have no ground for complaint.

It follows that the only way we can make sure of sending you the right combination of ingredients is to *know*, absolutely, what are the conditions to be met *in your particular case*.

So we positively decline to furnish Bird-Archer Boiler Compounds under the Bird-Archer Guarantee, until our Analytical Chemists have carefully examined a sample of your feed water, submitted a report of the trouble-making elements it contains and a written prescription to meet exactly the conditions found.

Our chemists' report, our estimate and Guarantee are then mailed to you, all without any charge, and you know then, definitely and positively, what we can do for you—what we have *got* to do, before the sale is finally effected. *You* simply *cannot* lose on this proposition. We shall not lose, because Bird-Archer Compounds will do the work—*your* work.

Send to-day, right now, before you lose your place on this page, for a copy of the Bird-Archer Guarantee and a copy of the Bird-Archer Treatise on "Boiler Troubles and Their Prevention." It really IS a treatise, and not merely an advertisement. And it is one of the most valuable things you can get free—merely for the small trouble of writing.

The Bird-Archer Company

90 West Street, New York

Canadian Representatives: LOWDEN & MEAD, 13 Bleury Street, MONTREAL

J-M Kearsarge Jointless Gaskets

A gasket is no stronger than its weakest point. J-M KEARSARGE JOINTLESS GASKETS have no taped joint, therefore no weak point. They are made of endless strips of asbesto-metallic cloth, folded and cemented with J-M Resisting Compound.

No Joints to Blow Out

Made from one solid piece of superior quality asbestos cloth with two fine brass wires twisted in each strand of the warp and one in each strand of the filler, J-M KEARSARGE GASKETS have exceptional strength and wearing qualities.

They will stand the highest temperatures of modern steam plants; will stand any steam pressure up to 250 lbs.; have exceptional strength and wearing qualities, consequently will outwear at least six ordinary gaskets; and are cheaper in first cost than ordinary high pressure gaskets because they are lighter, therefore you get more per pound.

It will pay you to investigate these gaskets.

Write nearest branch for Booklet.

The Canadian H. W. Johns-Manville Co., Limited

Manufacturers of Asbestos and Magnesia Products. ASBESTOS Asbestos Roofings, Packings, Electrical Supplies, etc.

TORONTO, ONT. MONTREAL, QUE. WINNIPEG, MAN. VANCOUVER, B.C.

For United States—**H. W. JOHNS-MANVILLE CO.**

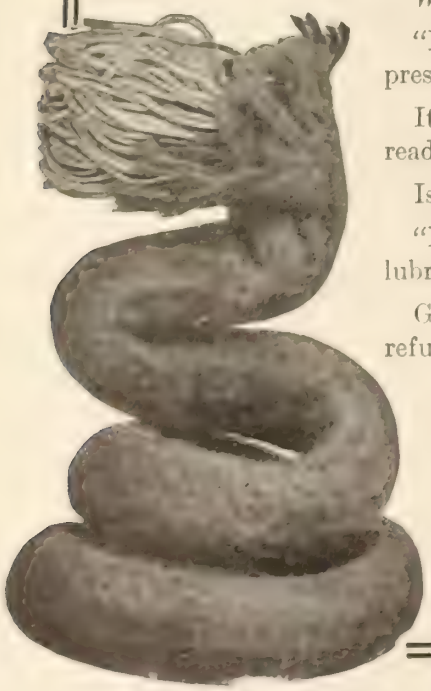
Baltimore Boston Dallas Chicago Cleveland London Detroit Kansas City Minneapolis Los Angeles Milwaukee Philadelphia New Orleans New York Pittsburg San Francisco Seattle St. Louis

733-2

Will you give

Premduro Packing

a thorough service test ?



We know just how good it is, and would like to have *you* convinced also.

"PREMDURO" contains no asbestos or rubber that scored rods or high pressure can affect, and is absolutely non-heating and non-scoring.

It is composed of triangular soft metal wires of special composition, and readily adapts itself to any surface.

Is simple to insert and costs less than any other efficient packing.

"PREMDURO" PACKING will be found to be very durable and is self-lubricating.

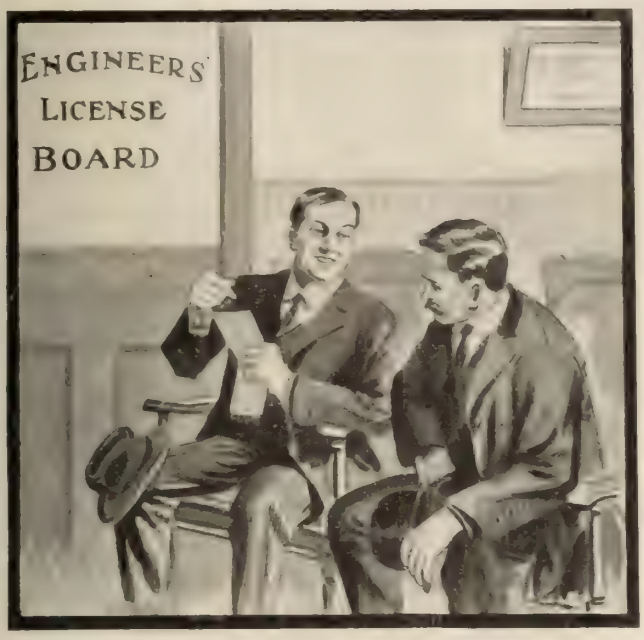
Give "PREMDURO" a fair trial—that is all we ask. We will cheerfully refund your money if it won't do all or more than we claim for it

Write for samples, literature and prices

Premier Engineering & Mfg. Co.

25 Broad Street, New York

The advertiser would like to know where you saw his advertisement—tell him.



"This Book Gives Me Confidence."

Our book of "Questions and Answers to Engineers' License Examinations" has given many engineers the confidence to face the License Board.

We will send you a copy ABSOLUTELY FREE, if you fill out and mail the coupon, then go to your dealer's and simply ***look at*** (not buy) Daniels' P.P.P. Red Packing.

How to get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and *look* at Daniels' P.P.P. Packing.

YOUR NAME .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF PACKING USED .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24D

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to dealer we name. Please do not call for book until we notify you.

Saved $590.00 a Year in Power Cost.

The following is from the report of tests made under the direction of the Dean of the Engineering Department of a great American University:

"Indicator-cards were taken from each end of the cylinder, the engine making about eighty revolutions a minute. The average totals per card for the ***fibrous*** sectional ring packing were ***71.27 horse-power.*** The engine being then packed with Daniels' P.P.P. Packing, and run under the same conditions, the average of total number of cards was ***63.85 horse-power.*** Thus the engine while using ***sectional packing*** required 7.42 ***more*** horse-power to drive, at the same speed, than while using DANIELS'

P.P.P.

ROD PACKING, ***which was equivalent to an increased friction on the rod of 11.62 per cent.*** 7.42 horse-power saved (by P.P.P.) at $80.00 per horse-power, per year. represented a saving of $590.00 per year in coal"—"Story of Some Friction Tests."

"Regular"

Made in Three Styles: "Regular," "Speclal," and "Marine." All styles are furnished in Coil, Spiral, and Ring forms.

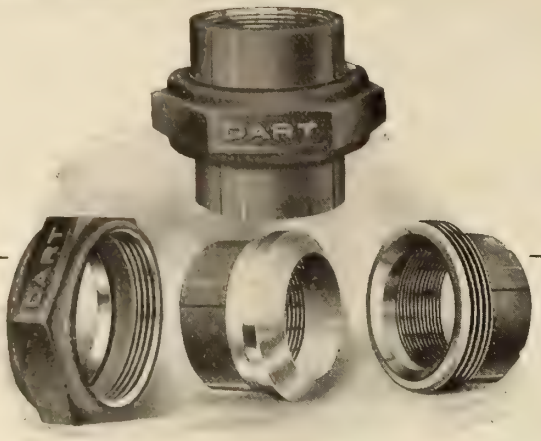
FREE to Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it with the Big red ***D***---cut from the box lid---and we will send you FREE a copy of the book direct. You'll not be required to go to your dealer for the book.

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS

Philadelphia, Pa., U.S.A.



EXPERIMENT

with all the unions you know of. There is no surer way of knowing their advantages and disadvantages. Compare the ease of installing, pressure, strain, durability, re-connecting and lasting qualities.

You are going to find that

DART UNIONS

will give you the most satisfactory results.

The two malleable iron sections of the Dart Union are seated with smoothly-ground bronze.

They come together in a ball joint that positively cannot leak under any circumstances.

And joints made with Dart Unions can be connected and disconnected almost instantly, whether pipes are in or out of line—joints that will stay tight until you deliberately loosen them.

Try it—the best union is the union for you. And your own experiment and comparison is our strongest argument for Dart Unions.

YOUR DEALER HAS THEM

DART UNION CO., LIMITED

TORONTO CANADA

TRADE DART MARK

Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

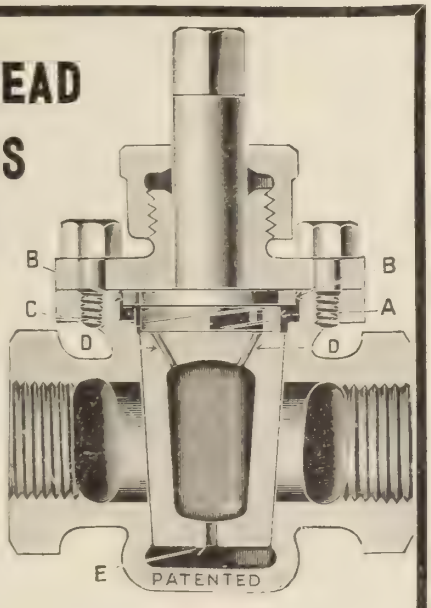
The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO

HOMESTEAD VALVES

Have no Equal for Simplicity and Durability



They are unexcelled for any service involving the handling of high pressures in steam, gas, water or hydraulic work. The seats are absolutely protected against wear. The plug is balanced and held in place by pressure when open, and when closed it is locked in the seat by our patent wedging cam. That's what makes Homestead Valves outwear all others.

A quarter turn opens or closes the valve---no waste of time or energy

A catalogue describing Homestead Valves is yours if you'll tell us where to send it.

Homestead Valve Mfg. Co.
Works: HOMESTEAD, PA.
P.O. Box 1754, Pittsburg

No Wooden Valves for Me

If you could get good service from valves made of wood, you would say "wooden valves for me!"

If materials didn't count, if good design was not worth while, if it made no difference whether the workmanship was good or bad, you would simply say to the nearest dealer, "Send me so many valves of such a size, wood or otherwise."

But you're not a fool.

You have learned that the best **workmanship** in the world would not make a strong valve out of weak, faulty metals

And that the purest valve **metal** would not be good enough to make a good valve from a bad design.

And that good metal, good workmanship, and good design make good valves **only** when all three are **combined**, and this combination **tested** and **double tested** before put into actual service.

Would you like to see good valves made?

Come to our factory any time; the latch string hangs out.

Welcome here.

We'll show you the metal we make our valves from—the purest metals, straight from the refineries.

Come into our Bronze Foundry. See the castings, **rich red bronze**, so perfect you'd not believe a flaw was findable. See one of the castings cut apart to test the section; note how **uniform** the walls, how **dense** and **solid.**

Watch them in their progress through our bronze machine shop; see the accurate tools, so closely gauged that one part does not vary so much as a hair from the other one.

Follow them to the "assembly" benches, where all the parts are put together—see how harmoniously every part fits into the others.

Then you will feel like saying—"that's the Valve for me!"

But no—not yet. That's not a Nelson Valve—not yet.

Come over to the testing tables. Here's a batch of a thousand valves we will ship to one of our warerooms.

"Standard"—we call them; guaranteed for 125 pounds working pressure. But before one of those valves gets to the shipping room the tester sets the pressure regulator to 250 pounds, **twice the pressure** the valve must stand in service; then see him test them, **one by one.** First on this side, then on that, under harder conditions than they will ever see in service.

You note **two** piles of valves.

Those in that box which are being carted to the scrap heap look very much like the others, but they will never see service, they can't get into our shipping room—**they have failed** on the test—our scrap pile's the place for them.

Those on the other table are Nelson Valves—Now we'll send them out, proud to put our name on them, because they have **stood the test.**

Some may be for **your own order**—how confident you feel that they will do your work since you have seen the stuff they are made of, how they are made, and how rigidly we have tested them so that they will stand the hardest bumps you can give them.

Good bye, Sir, come again.

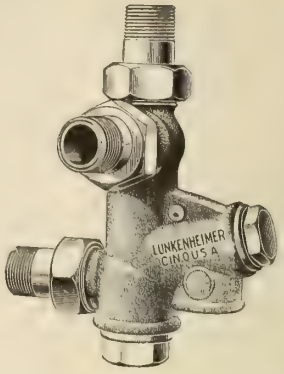
Nelson Valve Company
Philadelphia, Pa.

Montreal, 12-14 University Street.
New York, 30 Church St.
Chicago, 17 W. Kinzie St.
Pittsburg, 517 Liberty Ave.
San Francisco, 22 Battery Street.
Minneapolis, 622 Andrus Building.
Butte, Montana, 56 East Broadway.

Nelson Valves are made in the Gate, Globe, Angle and Check Types, in all sizes, of Iron, Bronze or Steel, for all Pressures, for any Service.

LUNKENHEIMER
Automatic Injectors and Ejectors

EXCEL THOSE OF ANY OTHER KNOWN MAKE. THEY WILL DELIVER MORE WATER PER POUND OF STEAM THAN ANY OTHER. WHICH MEANS A SAVING IN FUEL, AND THE MAXIMUM CAPACITY CAN BE GRADED OVER 50 PER CENT.



LUNKENHEIMER AUTOMATIC INJECTORS

WILL LIFT WATER QUITE A HEIGHT, TAKE VERY HOT WATER AND WILL FORCE AGAINST A MUCH GREATER PRESSURE THAN THAT OF THE BOILER. THEY ARE MADE IN FIVE TYPES TO FACILITATE CONNECTING.

YOUR LOCAL DEALER SHOULD HAVE THEM, IF NOT WRITE US.

THE LUNKENHEIMER COMPANY

LARGEST MANUFACTURERS OF HIGH-GRADE ENGINEERING SPECIALTIES IN THE WORLD.

GENERAL OFFICES AND WORKS,
CINCINNATI, OHIO, U. S. A.

BRANCHES { NEW YORK, 64-68 Fulton Street
CHICAGO, 186 North Dearborn Street
BOSTON, 138 High Street
LONDON, S.E., 35 Great Dover Street

Type "K"
Iron Body

Tested to 300 pounds hydraulic pressure.

Elliptical in design.

Double compensating bronze-faced discs.

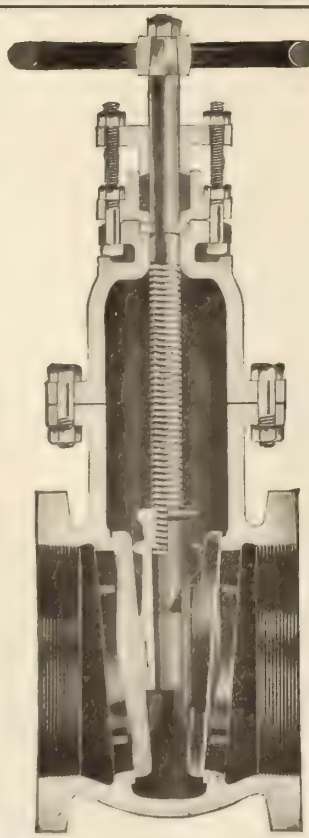
Can be re-packed while under pressure and wide open or closed.

Parts interchangeable.

Discs cannot jam.

Possess wide margin of safety.

Stocked by jobbers and dealers everywhere



Gate Valves
Bronze Mounted

Suitable for 125 pounds working steam pressure.

Design insures great rigidity and strength.

Heavy bronze seat-rings screwed into body and renewable.

Bronze disc-rings forced into double grooved recesses in discs.

Can be operated in any position.

Handsome appearance.

Dependable in service.

SEND for TYPE "K" Booklet

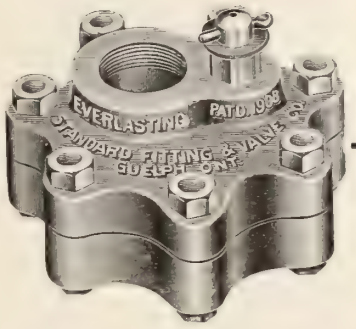
JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

ELIMINATE LEAKAGE

INSTALL

"Everlasting" Blow-off Valves

"Simple as A, B, C"

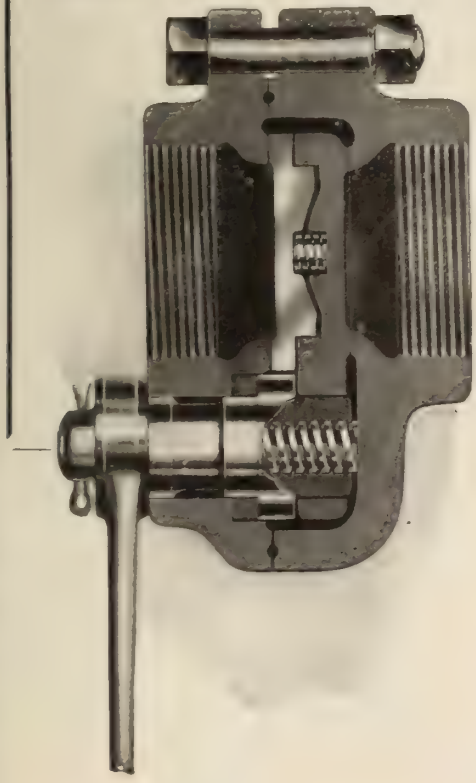


Every boiler has a Blow-off Valve that may be a source of definite and continued loss to you.

A leaky Blow-off Valve means extra coal consumption without returns in pressure. Experience has proven that most Blow-off Valves leak.

The "Everlasting" Will Not Leak

"EVERLASTING" Valves are made in semi-steel with working parts of naval bronze, in semi-brass with top bonnet of semi-steel, bottom bonnet of brass and working parts of naval bronze, and all brass with naval bronze working parts.



Made in Screwed and Flanged Styles

We are willing to take the verdict of the engineer as to the merits of the "EVERLASTING." Thousands of discriminating engineers have backed it up as the perfect Blow-off Valve. Thirty-four (34) railways in the United States and Canada have adopted it as an absolute standard, and a dozen or more large boiler makers consider it an indispensable accessory to a high-class boiler.

We also manufacture

THE POPULAR

SCREWED
FLANGED
LONG TURN

BRAND

STANDARD
EXTRA HEAVY
SEMI-STEEL

CAST IRON FITTINGS

Standard Fitting and Valve Company, Ltd.

GUELPH - - - ONTARIO

"Philadelphia" Compressed Air

Grease Cups

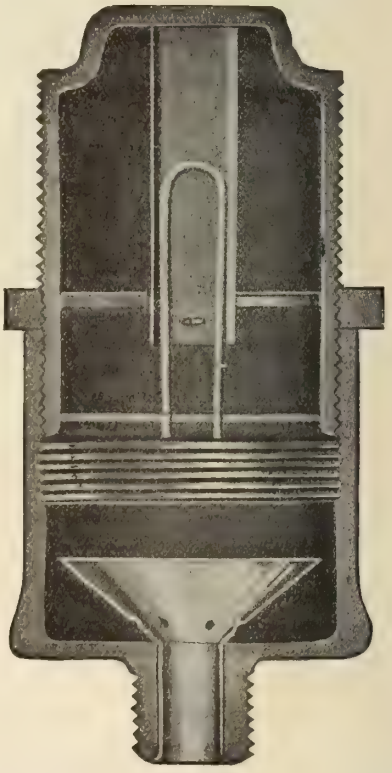
FIFTY PER CENT. SAVING GUARANTEED

Better and More Uniform Lubrication and Cheaper than Oil

Why?

1. Oil used on machinery bearings cannot be controlled. Grease, rightly made and properly applied, is under perfect control and can be so regulated in its application as to insure the least possible frictional resistance.

2. More oil is wasted by careless application, by dripping and by being thrown from the moving parts, than is actually used as a lubricant. Grease does not drip nor splatter, and cleanliness is the rule rather than the exception.



3. Dust and grit will work in where oil is used, causing greater friction and wear on the bearings, unless shut out entirely by the use of oil cellars or tight shields which are inconvenient, more or less expensive, and can be applied to comparatively few places. With grease there is no need of shields or similar devices; dust and grit are positively excluded from the bearings, the grease working out around the collars, etc., making a perfect seat, and there is practically no wear at all on the journals.

Grease is solidified oil, and will show less frictional resistance than liquid oil.

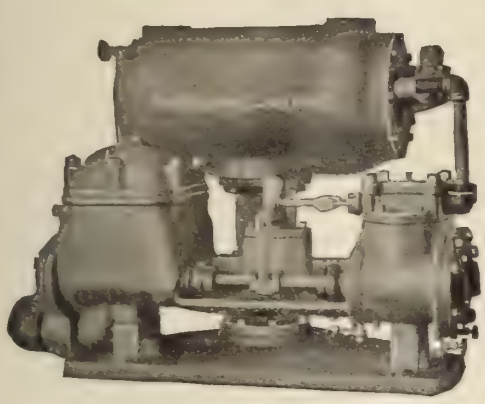
Your engine will not "heat up" Dirt and grit cannot enter your cylinders or bearings. You will save tremendously over the cost of oil.

Peterborough Lubricator Mfg. Co., Limited

PETERBOROUGH, ONTARIO

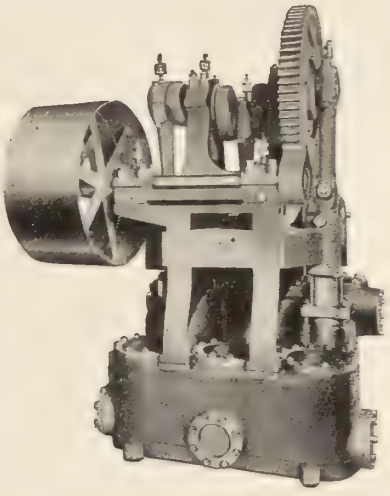
STEAM AND POWER PUMPS

OF EVERY DESCRIPTION

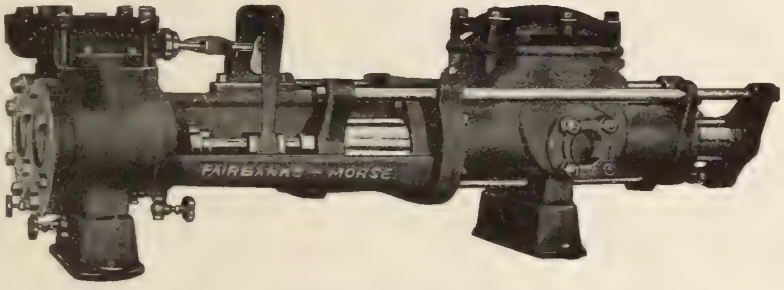


Duplex Automatic Feed Pump and Receiver.

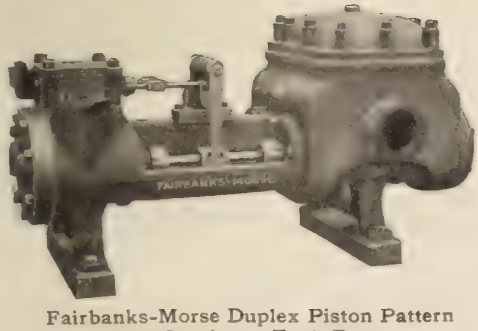
Profit by Our Experience



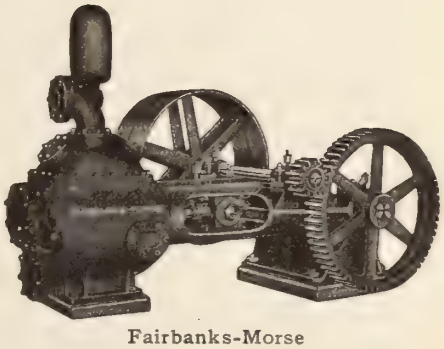
Triplex Power Pump.



Duplex Outside End Packed Plunger Pump



Fairbanks-Morse Duplex Piston Pattern
Low Service or Tank Pump.



Fairbanks-Morse
Duplex Power Pump.

Are you interested in a pump of any description, for any duty? We are manufacturers of, and selling agents for, a great variety of pumps, some of which are here represented. If you have not in mind the size and type of pump you require, we are prepared to figure upon your particular requirements and to suggest what would be most suitable for your work. In a word, we are at your service, and in order that we may make an intelligent recommendation, kindly give us full information as to your conditions and obtain the benefit of our expert opinion free.

The Canadian Fairbanks Co., Limited

Fairbanks Scales—Fairbanks-Morse Gas Engines—Safes and Vaults.

Montreal Toronto St. John, N.B. Winnipeg Saskatoon Calgary Vancouver

"THE Cyclone"

Shaking and Dumping Grate Bar

Will Prevent Clinkers from Clogging Your Grates

Experience has shown that the "CYCLONE" Grate Bar never warps, and is always in order, even after long use.

68% of Air Space, and
90% Under Draught

give the maximum results from cheap fuel, such as soft or hard coal coal screenings, hard or run-of-mine coal, etc.

ITS USERS ARE ITS FRIENDS.

The letter recited is one of dozens that will give us a similar enthusiastic testimonial.

The economy is too large to be neglected in any steam plant.

Illustrated Catalogue will be sent if you will give us your address. BEGIN THE SAVING NOW.

AGENTS.

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F. W. Blizzard Canada Permanent Chambers

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John G. Abraham - - 2844 Mance Street
Lowden & Mead 13 Bleury Street.

HAMILTON
Robt. Fitzsimmons - - 8 Grove Street

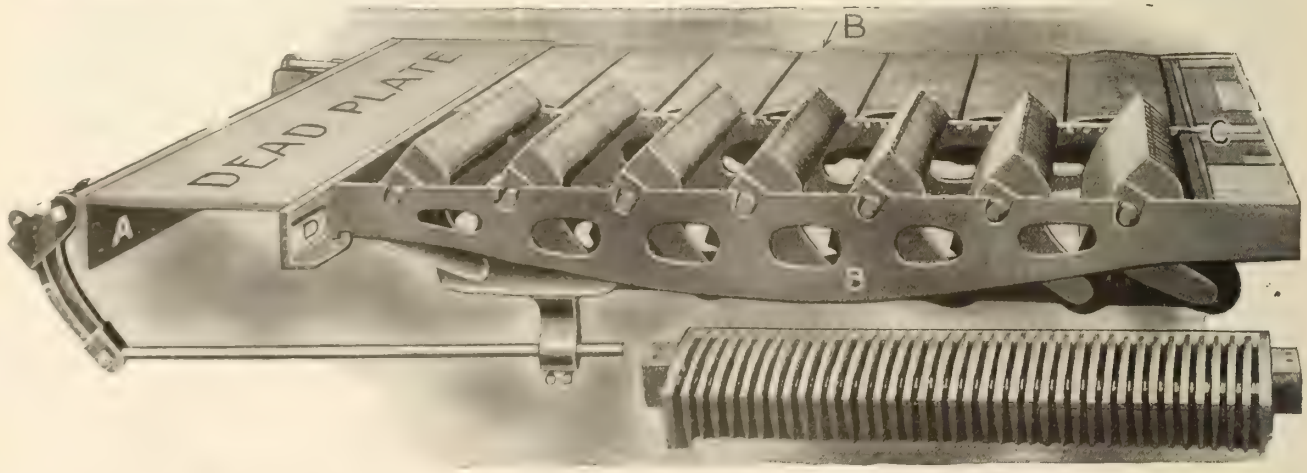
WINNIPEG
Vulcan Iron Works, Ltd.

CANADIAN BOILER EQUIPMENT CO.
TORONTO,

GENTLEMEN:

We are sending you to-night, through our Head Office in Montreal, an order for another set of Cyclone Shaking and Dumping Grate Bars for one of our boilers. We are glad to say that we have no reason whatever to regret the installation of the first set of these bars. We have had them in operation several months, and we find that we get more perfect combustion and much better fires and greater economy in our use of coal with these bars than we have had from any system of firing that we have tried at this mill. It is our intention, during the coming summer months, to complete the installation of these grate bars under our other four boilers.

Yours truly,
The Canadian Colored Cotton Mills Co., Ltd.
St. Croix Mill.
J. W. GRAHAM, Manager.



CANADIAN STEAM BOILER EQUIPMENT COMPANY, Limited

SOLE MANUFACTURERS FOR CANADA

186 QUEEN STREET EAST TORONTO, CANADA

A REMARKABLE TEST OF

MAGNOLIA

By the United States Government Using Water as a Lubricant

The "No. 2 Magnolia" mentioned in "TABLE E" contained the same proportions of tin, antimony and lead as the genuine "No. 1 Magnolia," but did not contain graphite nor was it treated by our special foundry process; however, it was made of virgin materials mixed in the ordinary way, and would class as a high grade babbitt.

TABLE E.—Giving results of combined ahead and reverse for friction test of Magnolia and "A" White Brass for each change of weight for 100 lbs. per square inch to 600 lbs. per square inch of projected area of bearing surface by increasing weight 100 lbs. per square inch at each change. **Lubricant: water.**

METALS.	Weight applied in lbs. per square inch.	Time in minutes.	Revolutions		Velocity or rubbing surface in feet per minute.	TEMPERATURE.										Co-efficient of friction.	Comparative values as anti-friction metals from the co-efficients.
			Total.	Per minute.		Of air in room				Of water bath.				Of test metal.					
						At beginning.	Maximum.	Mean.	Mean. increase.	At beginning.	Maximum.	Mean.	Mean. increase.	At beginning.	Maximum.	Mean.	Mean. increase.		
Magnolia No. 1	200	60	58.585	488.21	511.25	60.0	62.0	60.25	0.25	64.0	90.0	73.0	12.00	60.0	84.0	69.58	9.58	0.00159375	12.4811
" No. 2			58.835	490.29	513.45	62.5	64.0	63.16	0.66	91.0	98.0	95.50	4.50	84.5	94.0	91.58	7.08	0.0049479	4.0202
A white brass			58.170	484.75	507.63	59.5	66.0	62.66	3.16	85.0	154.0	131.41	46.41	78.0	144.0	123.16	45.16	0.0198916	1.0000
Magnolia No. 1	300	60	59.025	491.87	515.09	62.5	63.0	61.41	−1.09	79.5	80.0	72.58	13.08	60.0	77.0	69.66	9.66	0.00080208	
"	400	60	59.345	494.54	517.88	64.5	66.0	65.58	1.08	69.0	90.0	81.24	12.24	68.0	86.0	78.4	10.40	0.00129166	
"	500	60	58.650	488.75	511.82	72.0	76.0	73.33	1.33	77.5	142.0	105.33	28.83	77.0	130.0	98.58	22.58	0.002427	
"	600	60	58.870	490.58	513.74	68.5	71.0	68.25	−0.25	78.0	140.0	97.08	19.08	76.5	124.0	92.60	16.16	0.00275	

A "White" Brass could be tested up to only 200 lbs. per square inch, as the machine would not turn beyond that weight.

The Testing Machine turned easily up to 600 lbs. per square inch with the genuine Magnolia No. 1.

It was not thought necessary to test the No. 2 metal beyond 200 lbs. per square inch. The Water Test shows the true intrinsic value of Magnolia Metal as compared with other metals. It also demonstrates that a metal may show relatively the same analysis as Magnolia and yet fall far short of giving equal results; it also shows the destructive effect of frictional heat on even a very hard metal like white brass.

It will be observed that the genuine Magnolia Metal (No. 1) proved to be twelve times superior anti-frictionally to white brass, and three times superior to the No. 2 or ordinary grade babbitt.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

No. 225 St. Ambroise Street, MONTREAL

New York Chicago

SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK, containing 680 pages, treating on over two thousand Engineering and Mechanical Subjects, brought up to date. We offer this valuable reference work at the very low price of 40c postage prepaid. Address Montreal office.

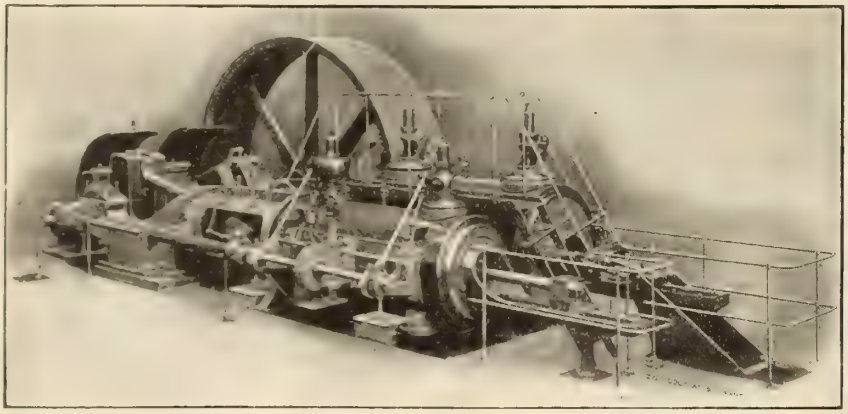
DOUGLAS & GRANT

KIRKCALDY, SCOTLAND

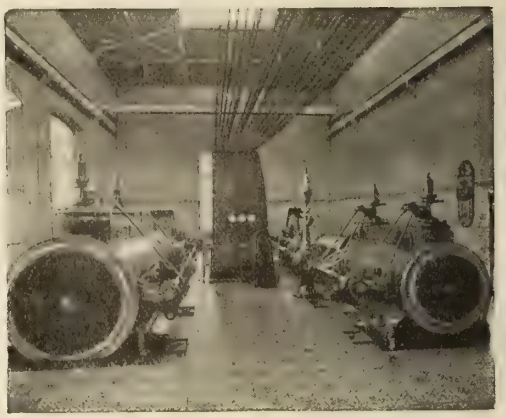
Sole Licensees for Great Britain and the Colonies of

Carels Drop Valve Steam Engine

For HIGHEST ECONOMY and RELIABILITY with Superheated Steam



700 I.H P. Side-by-Side Engine with Carels Drop Valves

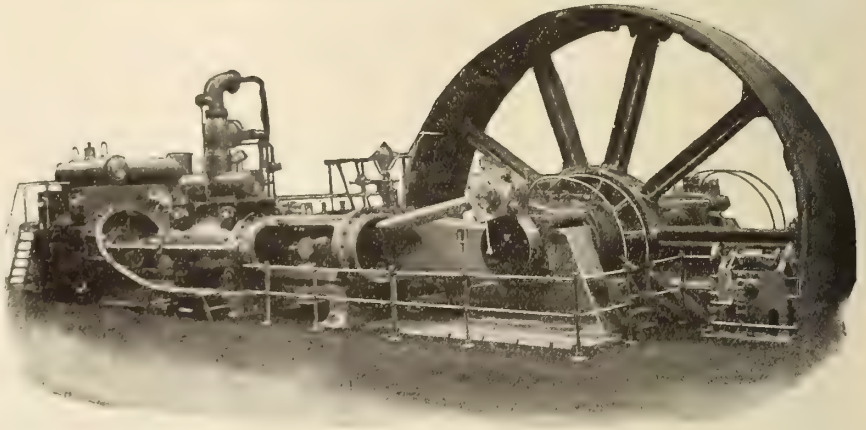


1500 I.H.P. Cross Compound Engine

ALSO MAKERS OF

CORLISS ENGINES

HORIZONTAL or
VERTICAL
SINGLE CYLINDER
TANDEM
SIDE-BY-SIDE or
CROSS COMPOUND
for any condition,
pressure or
superheat.



1400 I.H.P. Tandem Corliss Engine

All Classes of Condensing Plants, JET, SURFACE or AERO, the latter using air only for cooling, requires no water supply, and most of the condensed steam is used again in the boiler. Makers of Steam and Electric Haulages and Winding Engines, Large Pumps for Waterworks and Mines.

On British Admiralty and India Office Lists. A1, ABC, Bedford McNeil's and Engineering Codes.
Cable Address—DOUGLAS, KIRKCALDY

Agents for Canada

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Bainmit, Montreal

Bain & Mitchell, Montreal

Phone
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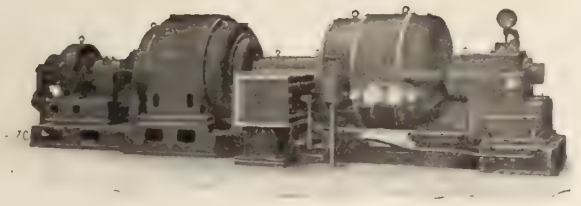
BELLISS STEAM TURBINES

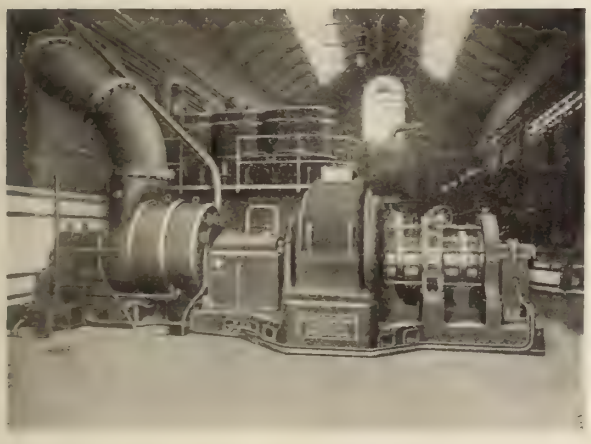


For High Pressure or Exhaust Steam or a Combination of Both.

It is of equally high grade with the Belliss Reciprocating Engine so well known in Canada.

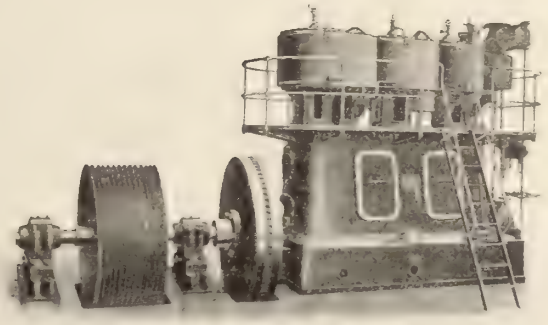
Impulse Type—No small clearances in vicinity of the fixed or moving vanes.

The Belliss is the only drum built Turbine on the market which cannot strip.



Belliss Exhaust Turbine in Central Station.

A Belliss Reciprocating Engine combined with Exhaust Turbine gives unparalleled economy.



BELLISS ENGINES FOR BELT AND ROPE DRIVE.

Quotations given for complete plants erected anywhere in Canada.

Write us for Turbine Pamphlet

Laurie & Lamb

CONSULTING AND CONTRACTING ENGINEERS

211 Board of Trade Building, - - - - Montreal

Sole Agents for BELLISS & MORCOM Limited, Birmingham, Eng.

THE JOHN INGLIS COMPANY, Limited

ENGINEERS and BOILERMAKERS

Have an

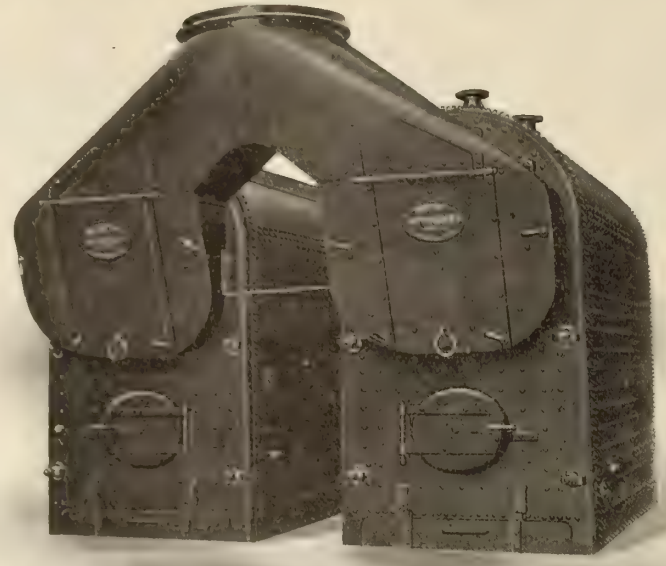
"INGLIS" Boiler

if you want the Best.

Prices Right

Quick Delivery

First-Class Workmanship



Fitzgibbon Boilers.

"Boilers"

Fitzgibbon Return Tubular

Locomotive

Scotch Marine

Scotch Dry Back

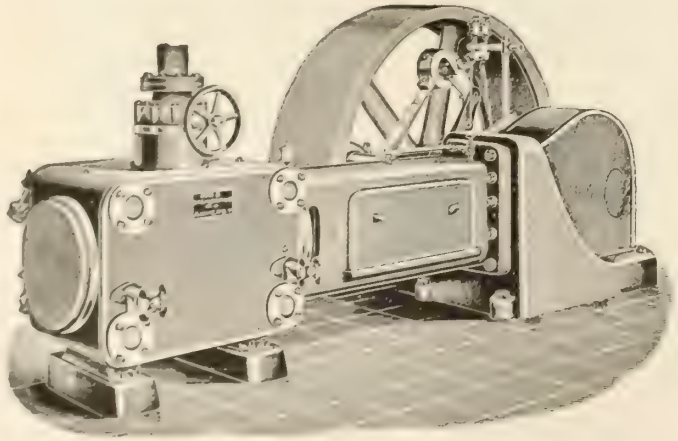
Vertical Submerged Tube

Water Tube

If You Contemplate Buying a Boiler of any Kind, Give us an Opportunity of Serving You.

14 STRACHAN AVENUE TORONTO, Canada

Robb Corliss Engines



Have the Armstrong-Corliss valve gear, which will operate at a higher speed than the ordinary releasing gear.

This valve gear does not depend on springs or dash pots for closing, and runs without noise.

The wearing parts of the valve gear are enclosed in a casing and run in oil so that friction is reduced to a minimum.

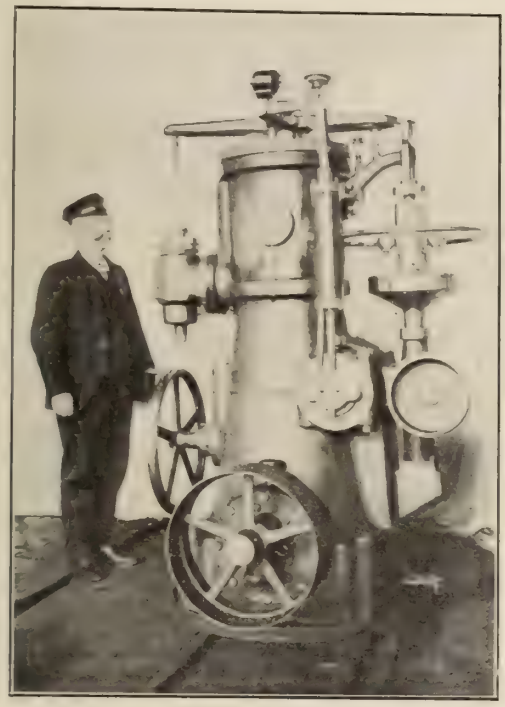
Robb Engineering Co. LIMITED

AMHERST, N.S.

DISTRICT OFFICES

Canadian Express Building, Montreal		R. W. Robb, Manager
Traders Bank Building, Toronto	-	Wm. McKay, "
Union Bank Building, Winnipeg	-	W. F. Porter, "
Grain Exchange Building, Calgary	-	J. F. Porter, "

The advertiser would like to know where you saw his advertisement—tell him.



GOVERNORS

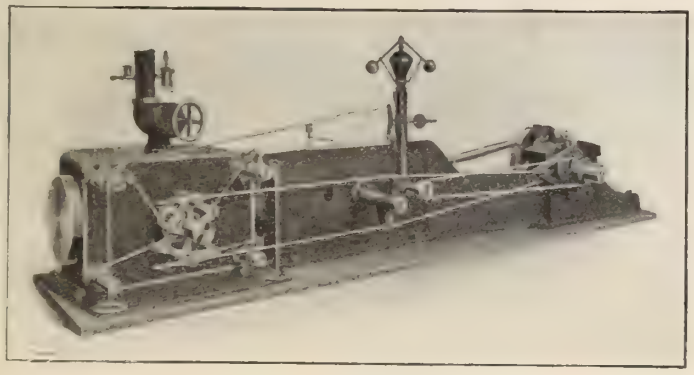
THIS picture shows one of the Governors we supplied to the Calgary Power Co. for regulating the speed of a 3750 H.P. Turbine. It is the **most compact** and **reliable** governor on the market. Notice the **absence** of all racks and pinions—things which are liable to **wear out very soon**. Note also the **presence** of a **guide bearing** on the top of the flyball shaft—very seldom used on Governors of other makes.

We manufacture seven different sizes of Governors suitable for all conditions.

The Canadian Boving Company, Limited

164 BAY STREET, TORONTO

Leonard Corliss Heavy Duty Engine



¶ Economical, Durable, Equal to the Best and Superior to Most Other Corliss Engines on the Market.

Particularly adapted for Severe and Continuous Work, such as required for Electrical, Traction and Rolling Mill Work.

MADE BY

E LEONARD & SONS, London, Ontario

Manufacturers of High and Slow Speed Engines of all kinds.
Boilers, Heaters, Pumps, Complete Steam Plants with Accessories.

Canadian Agents for "Browett-Lindley" English High Speed Engines and "National" Gas Engines and Producers.
Warehouses and Agencies at Montreal, Que.; St. John, N.B.; Calgary, Alta.; Winnipeg, Man: Vancouver, B.C.

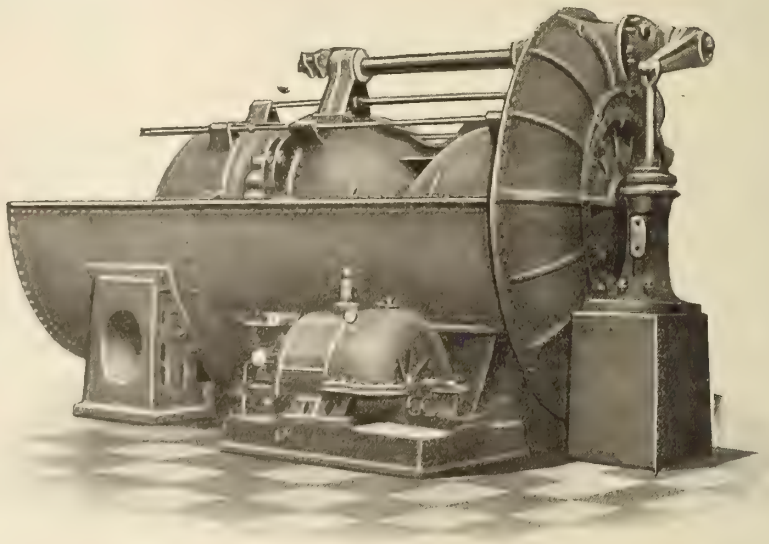
WATER POWER PLANTS

UNIQUE EXPERIENCE
5,000 TURBINES SUPPLIED

2,000,000 Horse Power
At Present 400,000 H.P. on order
Any Head from 1 to 3,100 Ft.

2 Turbines as illustration on order for the Western Canada Power Co., Vancouver, 13,000 H.P. each

(3,000 K.W. Zoelly Steam Turbine in front.)



ESCHER, WYSS & CO.
ZURICH, SWITZERLAND

CANADIAN OFFICE:

TORONTO, LUMSDEN BLDG., R. 408

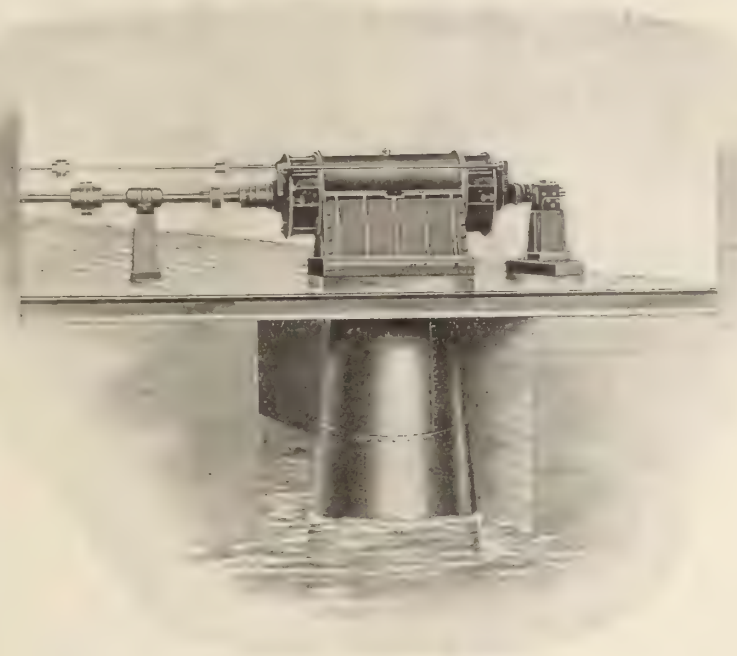
PHONE 234, ADELAIDE

The CANADIAN TURBINE

is eminently adapted for

Mill and Factory Drives and Electric Plants

You are always sure of good, practical results in Power, Economy and Easy Governing.



Horizontal Pair—Centre Discharge.

With "The Canadian Turbine" and the experience we place at your disposal you are absolutely assured that you have all that can be got out of your water privilege

Chas. Barber & Sons - Meaford, Ont.

Samson Turbines

combine the best features of the old and tried Leffel Wheels with new features of their own.

The double wheel and easily operated balanced gates have been retained.

The result is more power in more concentrated space, at greater velocity, than in any previous type.

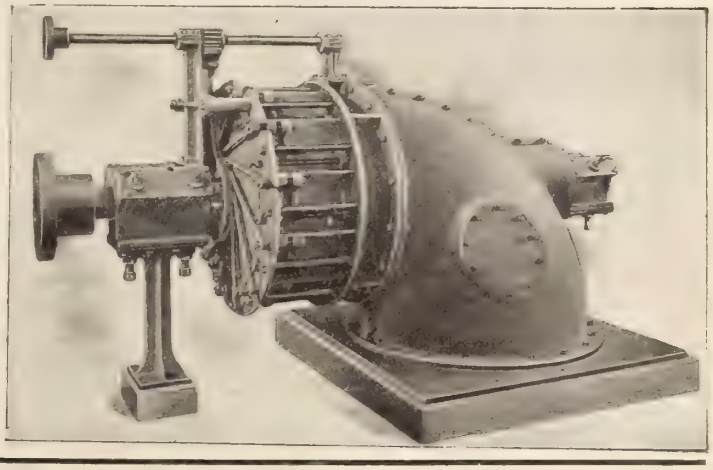
SAMSON TURBINES FOR WATER POWER

are built for special conditions on your specifications of capacity, position, etc., and are guaranteed to give unexcelled performance with a wonderful mechanical efficiency.

Over a million and a half horse power

is being developed by wheels of this type.

Advise us of your problem and we will give it careful consideration.



WILLIAM HAMILTON CO. LIMITED

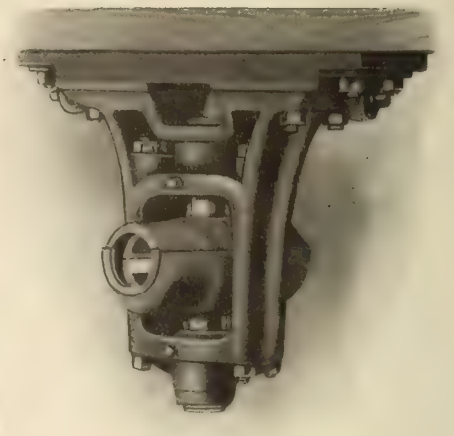
PETERBOROUGH, ONTARIO

Ways and Means for the Transmission of Power

WE TAKE COMPLETE CONTRACTS FOR SUPPLYING THE MATERIALS FOR ALL SORTS OF POWER TRANSMISSION AND ALSO SUPPLY ANY AND ALL NEEDS IN THESE LINES COVERED BY OUR LARGE STOCK OF THESE MATERIALS

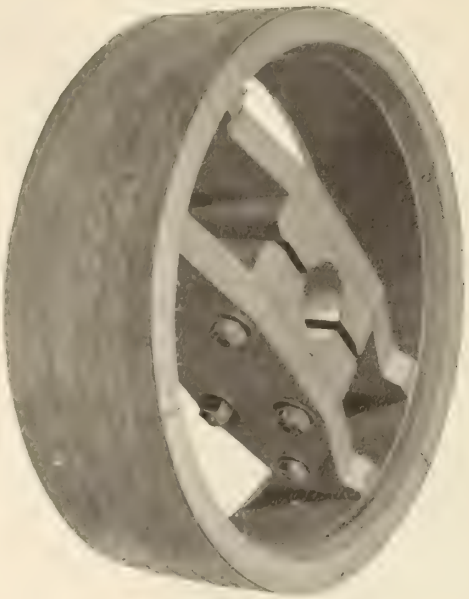
HANGERS

of every sort needed for the most complicated systems of transmission.

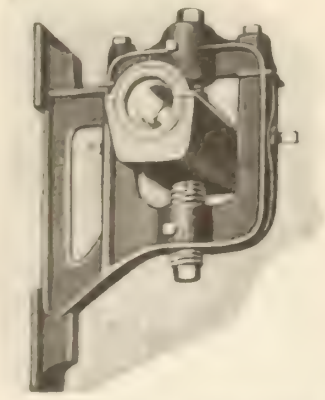


Our Wood Split Pulleys

Have the arms properly tenoned into the rim, a perfect glue-joint being made, after which they are firmly doweled.



Each and every segment of Rim is thoroughly nailed



Heavy Head Shafts
Hangers
Pillow Blocks
Post Boxes
Friction Clutches
Ball Bearings
Beltings
Etc.

SEND FOR CATALOG "B"

Giving particulars of our appliances and price lists

Sole Eastern Agents for Wood Pulleys—THE A. M. ELLICOTT CO'Y, Montreal

The ELMIRA MACHINERY & TRANSMISSION CO., Limited

ELMIRA ONTARIO

"I'LL MAKE ASSURANCE DOUBLE SURE AND TAKE A BOND . ." Shakespeare

WICK OILING

RING OILING
WICK OILING
GREASE
AND
GRAPHITE
BEARINGS

GRAPHITE

SAME FRAME FOR ALL

If it Isn't Here Let us know We'll Make it

BOND DOUBLE SURE TRANSMISSION

Keep your Eye on THIS PAGE Each Month

GREASE

These Bearings also Interchange with our Pedestal Pillow Blocks Post Hangers Universal Pillow Blocks and Bracket Hangers

MAY WE SEND OUR CATALOG X?

4 OF A KIND HARD TO BEAT

RING OILING

MANUFACTURED BY

Canadian Bond Hanger and Coupling Co., Limited
Alexandria, Ontario.

"Positive" Facts

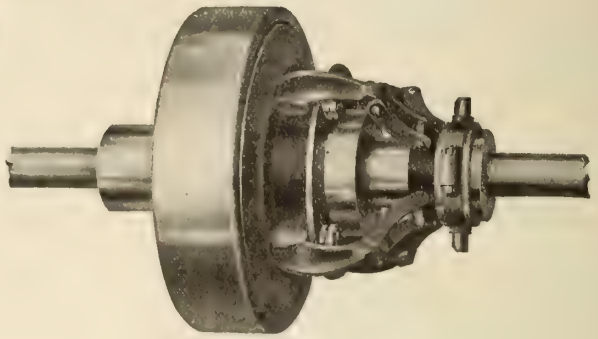
Positive Clutches will

OUTWORK

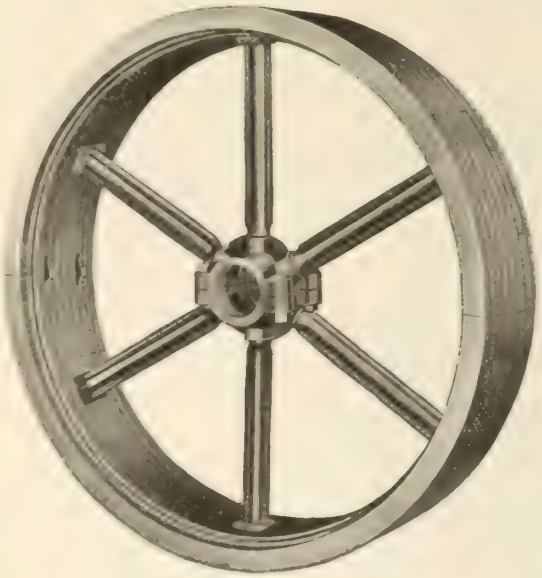
OUTWEAR

OUTLIVE

Any Friction Clutch made.



A Jaw Clutch which can be Operated at Any Speed and Under Any Load.



"Positive" Combination Split Pulleys

Wood Rim Waterproof

Steel Arms

Malleable Hub

Cast-Iron Interchangeable Bushings

Save 50% of Power Lost in Slippage of Belts on Metal Rims.
Save 98% of Power consumed by Wood Pulleys in Windage.
Save 59% of Power consumed by Wood Pulleys in Balance.
Save 12% of Power consumed by Wood Pulleys in Weight.

Positive Clutch & Pulley Works, Ltd.

11-13 JARVIS STREET TORONTO

*The advertiser would like to know where you saw his advertisement—**tell him.***

These Tests Prove That Cling-Surface Treatment Pays

Every engineer, manager and belt man should be interested in these curves which represent results of tests by Prof. R. C. Carpenter and others at Cornell University on belts before and after Cling-Surface treatment.

Fig. 1. Belt speed 4,500 ft. per min. The lower curve is characteristic for an untreated belt—more power demanding more initial tension. Note the difference after applying Cling-Surface as shown by the other curve. Even under extreme initial tension the belt output is *much* better after using Cling-Surface, while with no initial tension other than due to the weight of the belt, the power output is *40 per cent. greater than from the untreated belt under the highest initial tension, and 14 times as great as from the untreated belt under the same tension conditions.* In short, the belt does far more work at all tensions after applying Cling-Surface.

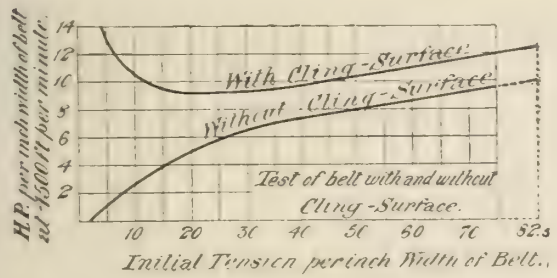

H.P. per inch width of belt at 4500 ft per minute
With Cling-Surface
Without Cling-Surface
Test of belt with and without Cling-Surface.
Initial Tension per inch Width of Belt.

Fig. 2. Belt speed 2,200 ft. per min. The results at this slower speed are much the same—always greater transmission efficiency with Cling-Surface, greatest efficiency under least initial tension, and this better than for an untreated belt at its best.

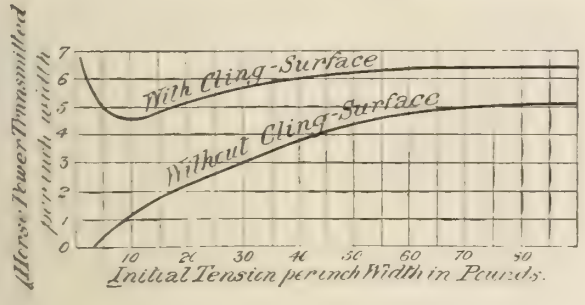
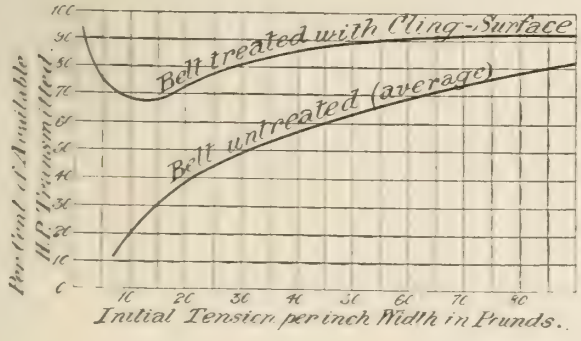

Horse Power Transmitted per inch width
With Cling-Surface
Without Cling-Surface
Initial Tension per inch Width in Pounds.

Fig. 3. Average efficiency in percentage of power transmitted by four untreated belts compared to efficiency of one of these after subsequent Cling-Surface treatment. Same general results as in Figs. 1 and 2. At 2 lbs. initial tension (the weight of the belt), the treated belt was 95 per cent. efficient as against 15 per cent. before using Cling-Surface. Even under 90 lbs. initial tension, the treated belt transmitted 16 per cent. more power than before.


Per Cent. of Available H.P. Transmitted.
Belt treated with Cling-Surface
Belt untreated (average)
Initial Tension per inch Width in Pounds.

The above are not exaggerations, but simple every day cases such as are likely to be found in your own plant. Adding Cling-Surface to a belt and slackening it invariably *increases the power transmitted, while the slacker it runs (until the sides touch) the more and more it will transmit.* In other words, a belt treated with Cling-Surface makes useful work from power otherwise lost in overcoming the added journal friction produced by the useless initial tension. Further, these results are not merely for an hour or two after applying the Cling-Surface, but the *constant daily* savings that follow intelligent, systematic belt treatment. Once a belt is filled with Cling-Surface, further applications are seldom required to make the benefits lasting. In view of this and the assured saving, and the preservative effect of Cling-Surface in keeping the belts pliable, clean, water-proof, moist and free from cracks, you can well afford to investigate. A trial of Cling-Surface costs practically nothing and the results are guaranteed on a money back basis.

Ask for literature and names of nearby plants where you can see what Cling-Surface is doing.

Cling-Surface Company

1057 NIAGARA STREET BUFFALO N Y

New York Boston Chicago St Louis Denver Atlanta Memphis Toronto Etc
London Thomas & Bishop 119-123 Finsbury Pavement E C
Paris 74 Rue des Ecluses St Martin Barmen Oskarstrasse 2

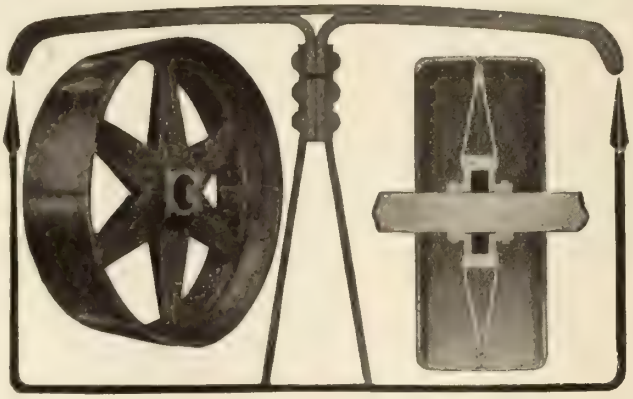
A New Department

We recently became the sole Canadian Agents for the Philips Pressed Steel Pulley Works and have put in a large stock of this widely-known Pulley.

Note the Construction of the

PHILIPS RIM

One single sheet of steel pressed so as to give double thickness and very stiff flanges, also the heavy central rib to which the spider is attached.



Notice the even surface this rim presents to the belt. There are no grooves or rivet holes to break the surface of contact. This means increased power for you and less wear and tear on journals and shafting.

More particulars if you will drop us a postal

IMPORTANT NOTICE RE "CAST IRON PULLEYS"

We keep the only full stock of 6in., 7in., 8in., 9in., 10in., 11in., diameter and all widths of face.

Our Pulleys are of elegant design, of light but strong pattern, all split, and fitted with interchangeable bushings, bored and reamed to perfect size of shaft, therefore easily fitted up---No keys, keyways or set-screws required. Our price is right and our service prompt. We also carry full stock of

"THE PHILIPS STEEL PULLEY"
from 12in. to 48in. diameter and all widths.

It is to the interest of the Superintendent, the Purchasing Agent and Master Mechanic to note the above.

D. K. McLAREN, LIMITED

MONTREAL
309-311 Craig Street West

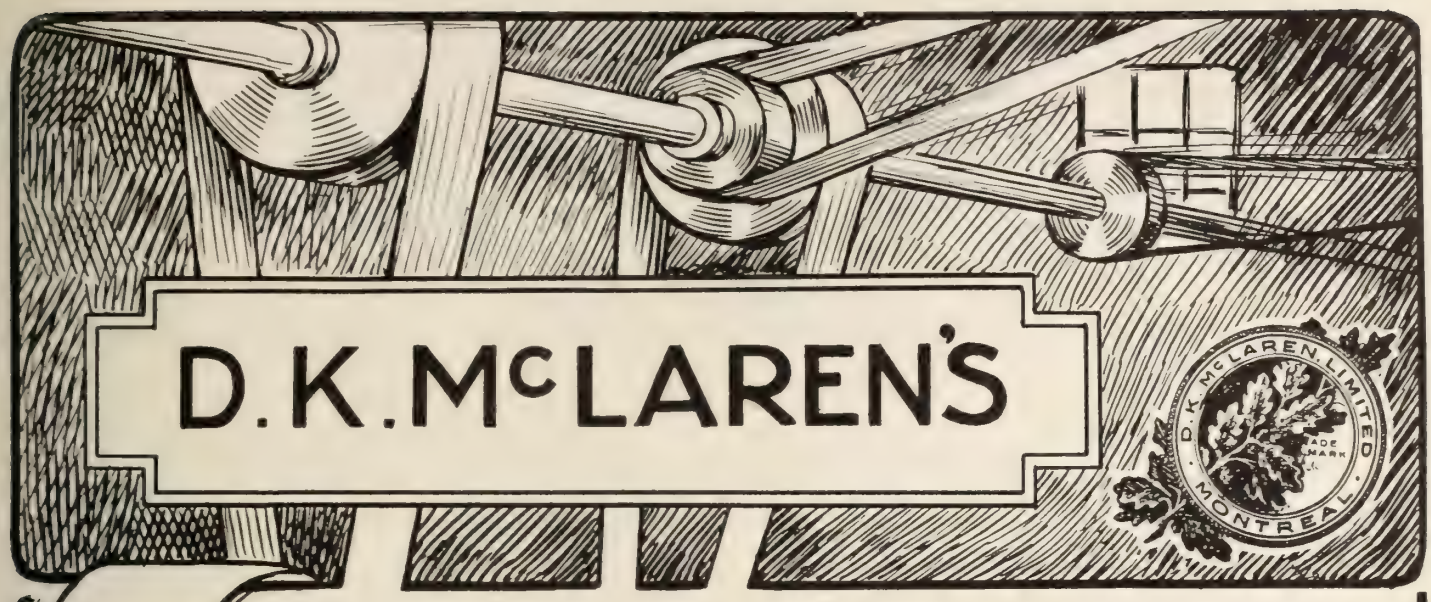
TORONTO
200 King Street West

QUEBEC
21 St. Peter Street

ST. JOHN, N.B.
64 Prince William Street

VANCOUVER, B.C.
37 Alexander Street

The advertiser would like to ***know where you saw his advertisement—tell him.***



Genuine·British·Oak·Tanned LEATHER·BELTING

THE perfect quality of the leather, and special processes of manufacture, have given our belts a great reputation for reliability and durability.

We make special Belts for your peculiar requirements and guarantee them absolutely.

Our regular Extra C Beltings we carry in stock at all our warehouses for immediate shipment, and also a full stock of Mill Furnishings.

ADVISE US AND WE WILL HELP YOU.

D. K. McLaren, Limited

MONTREAL
309-311 Craig Street W.

TORONTO
200 King Street W.

QUEBEC
21 St. Peter Street

ST. JOHN, N.B.
64 Prince William Street

VANCOUVER, B.C., 37 Alexander Street

CLIMAX
LEATHER BELTING

PERHAPS YOU DON'T CARE

how your Belting is made if it does its work.

But the material and making of a belt determine its life and history.

"CLIMAX" Belts are made from selected leather, cut and cemented with a care that gives them a length of service, and they are more than satisfactory in use.

Don't Buy Belts On Looks

Fit your transmission with "CLIMAX" Belting, and you will acquire an experience in good Belting that will prevent all future mistakes in selection.

MADE IN CANADA'S BEST FACTORY

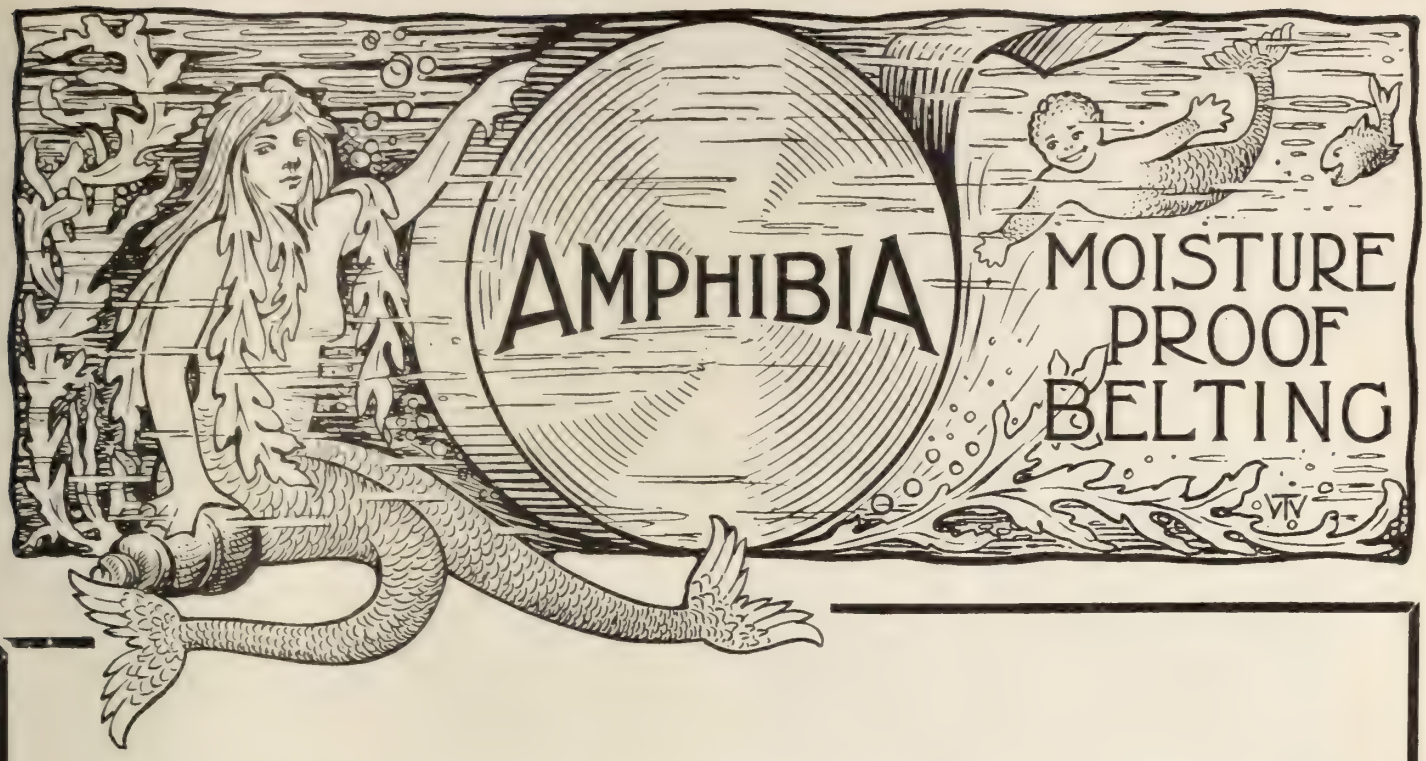
Sadler & Haworth

ESTABLISHED 1876

MONTREAL, 511 William St. TORONTO, 27 Melinda St.

ST. JOHN, N.B., 89 Prince William St. WINNIPEG, 244 Princess St. VANCOUVER, B.C., 217 Columbia Ave.

TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN



YOU CAN BE CERTAIN OF GOOD SERVICE FROM "AMPHIBIA" BELTING no matter how damp the place may be where you must use it.

PUT THIS CERTAINTY INTO YOUR CALCULATIONS when buying belting for saw mills, pulp mills, woolen mills, laundries, brick yards, tanneries, breweries, etc., where the location is either damp or doubtful.

"AMPHIBIA" WATERPROOF BELTING could be used under water without harming it in any way.

"AMPHIBIA" Heavy Single is made for extra heavy work from very thick leather.

"AMPHIBIA" Light Double will take moderate power over small pulleys.

"AMPHIBIA" Heavy Double is the giant belt intended for heavy mill work.

"AMPHIBIA" Planer for the particular work on wood planers.

"AMPHIBIA" Special Laundry for the wash wheels.

Guaranteed Waterproof — The First of its Kind in Canada

Sadler & Haworth

ESTABLISHED 1876

MONTREAL, 511 William St. TORONTO, 27 Melinda St.

ST. JOHN, N.B., 89 Prince William St WINNIPEG, 244 Princess St. VANCOUVER, B.C., 217 Columbia Ave.

☞ TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN ☜

The advertiser would like to know where you saw his advertisement—tell him.

BELT PREFERENCE IS FOUNDED ON EXPERIENCE

GOODHUE BELTS

Are Preferred by Many of the Largest Canadian Power Plants Because

THEY SAVE BOTH TIME AND MONEY

The GOODHUE Belts stretch less than ordinary Belts, fully 15 per cent. to 25 per cent

There is less waste in material cut out, every ounce of Belting doing its full share of work during the entire life of the Belt.

There is less danger of loosened Belts and the consequent loss of power and risk of accidents.

USE PROVES THEIR SUPERIORITY

According to the intended use we recommend the

"Extra," "Standard," or "Acme" Waterproof Belts

WRITE TO-DAY FOR DETAILS AND PRICES

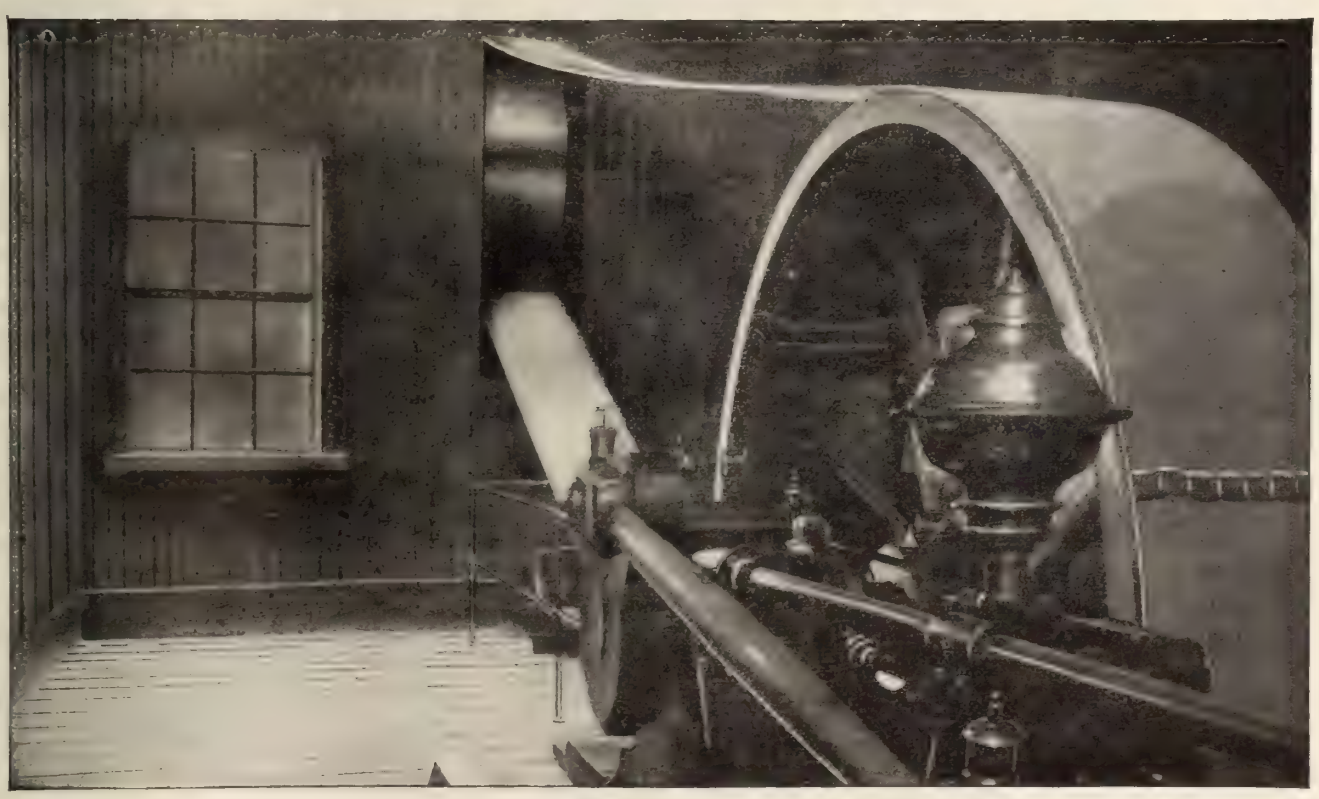
J. L. Goodhue & Co., Limited

DANVILLE, P.Q.

SCANDINAVIA
FEDERAL ENGINEERING & SUPPLIES LIMITED
TORONTO
BELTING

For Conveying and Transmission

May be used equally well in both **WET** and **DRY** places



SCANDINAVIA as a Main Drive Belt

SCANDINAVIA Belting is solid woven. There are no plies to come apart.

For any straight or crossed drive SCANDINAVIA in every case is without a superior on the market for **Strength** and **Durability.**

Write for prices and our circular "D"

Federal Engineering & Supplies, Limited

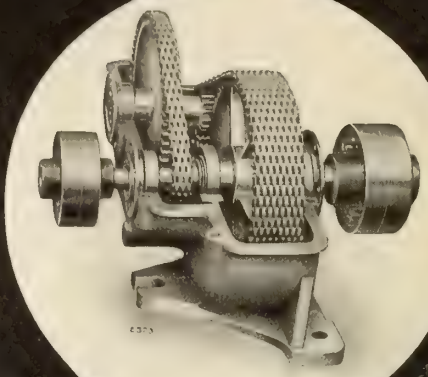
284 YONGE STREET, TORONTO

STOCK CARRIED AT :—MONTREAL, Federal Engineering & Supplies Ltd., 329 St. James St. CALGARY, Great West Saddlery Company. COBALT, Geo. Taylor Hardware Company. OTTAWA, McDougal's Limited. QUEBEC, Jos. Ouellet, 12 Rue Caron, Jacques-Cartier. ST. JOHN, Kinnear & Company. HALIFAX, Geo. B. Oland & Company.

Coventry

"NOISELESS" DRIVING CHAINS

Give Economical and Efficient TRANSMISSION of POWER.



The above cut shows one of the manifold applications of "COVENTRY" Driving Chains—a Speed-Reduction Gear Box, designed and built by the COVENTRY CHAIN COMPANY, of Coventry, England.

The Mechanical Efficiency of this Gear was found on test to be 97%

Think what that means! A total loss due to journal friction, oil resistance and internal power consumption of only 3%

Let us take care of your Specifications. We can give you equally good results.

Sole Canadian Distributors:

John Millen & Son

LIMITED

Montreal, Toronto, Winnipeg, Vancouver

Address all communications to 421 St. James St., Montreal

RENOLD PATENT SILENT CHAINS

What Users Think

MONTREAL, Feb. 8, 1909.

Messrs. Jones & Glassco, Montreal.

RE RENOLD SILENT CHAIN DRIVE.

GENTLEMEN,—In reply to your enquiry of Jan. 30th, I may say that the Reynold Silent Chain Drives we have installed are giving every satisfaction.

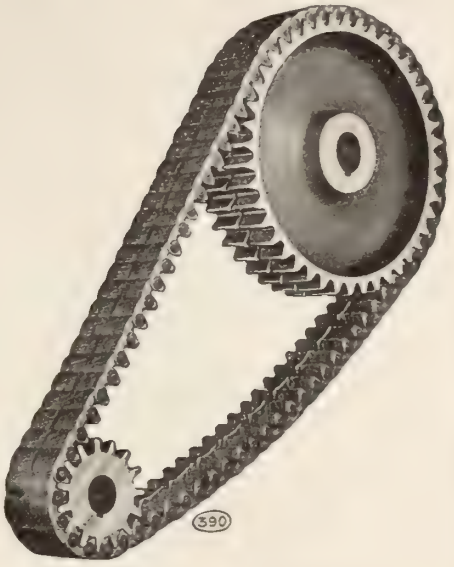
Our first drive was installed to replace a 12 in. belt which was giving us trouble on account of short centres; this chain has run continuously for four years without the slightest trouble.

Our second drive was installed on a mixing machine doing heavy duty and which had previously broken up two sets of spur gearing; this chain has run over three years with no sign of wear yet.

Our third drive was installed on a calendering machine after breaking two sets of helical gears and this has been so successful that we are now installing two more similar drives.

I would be perfectly willing to make an appointment with any person genuinely interested and show him the drive in operation.

The above comes from one of the largest manufacturers in Montreal and is signed by the Mechanical Superintendent. Up to the present (1911) these drives have not received repairs of any kind.



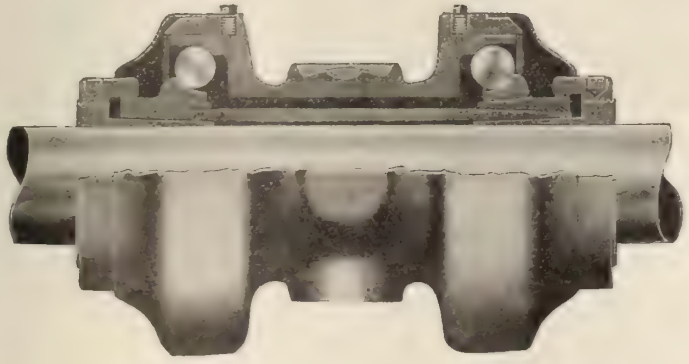
Write for particulars

Sole Canadian Agents

Jones & Glassco : : Montreal

Power Talk No. 6

CHAPMAN DOUBLE BEARINGS



SAVE

15% to **35%** of your entire power.

95% of your lubrication and attention.

Wear and tear on your entire transmission equipment.

They Fit any Standard Adjustable Hanger

It will pay you to let us figure on your new equipment or on changing your old one to a modern basis.

Consult Us on Loose Pulley and Friction Clutch Pulley Troubles

The Chapman Double Ball Bearing Co. of Canada, Ltd.

339-351 SORAUREN AVE. TORONTO, CANADA

POWER TRANSMISSION APPLIANCES

Wood Rim Split Pulleys

Our W.R.S. Pulleys are of a specially strong design, and are so constructed that the arms do not act as a fan. The hubs have a positive grip on shaft.

Iron Pulleys

We make all sizes of Iron Pulleys, both of the plain and split design.

Bearings, Couplings, Etc.

Our stock of the most modern designs of Bearings, Friction Couplings, Couplings, Etc., is most complete.

Gearing

We have machinery that makes it possible to turn out all kinds of Spur, Bevel and Mitre Gears in a prompt and careful manner.

Shafting

We handle the best grade of Steel Shafting in all diameters.

Our line of Transmission Machinery is complete and up-to-the-minute in Quality, Design, Etc.

ASK FOR OUR BOOKLETS, PRICES, ETC., IN THIS LINE

The Goldie & McCulloch Co., Limited

GALT, ONTARIO, CANADA

WESTERN BRANCH
248 McDermott Ave., Winnipeg, Man.

MARITIME PROVINCES
13-15 Dock St., St. John, N. B

QUEBEC AGENTS
Ross & Greig, 412 St. James St., Montreal, Que

B. C. SELLING AGENTS
Robt. Hamilton & Co., Vancouver, B. C.

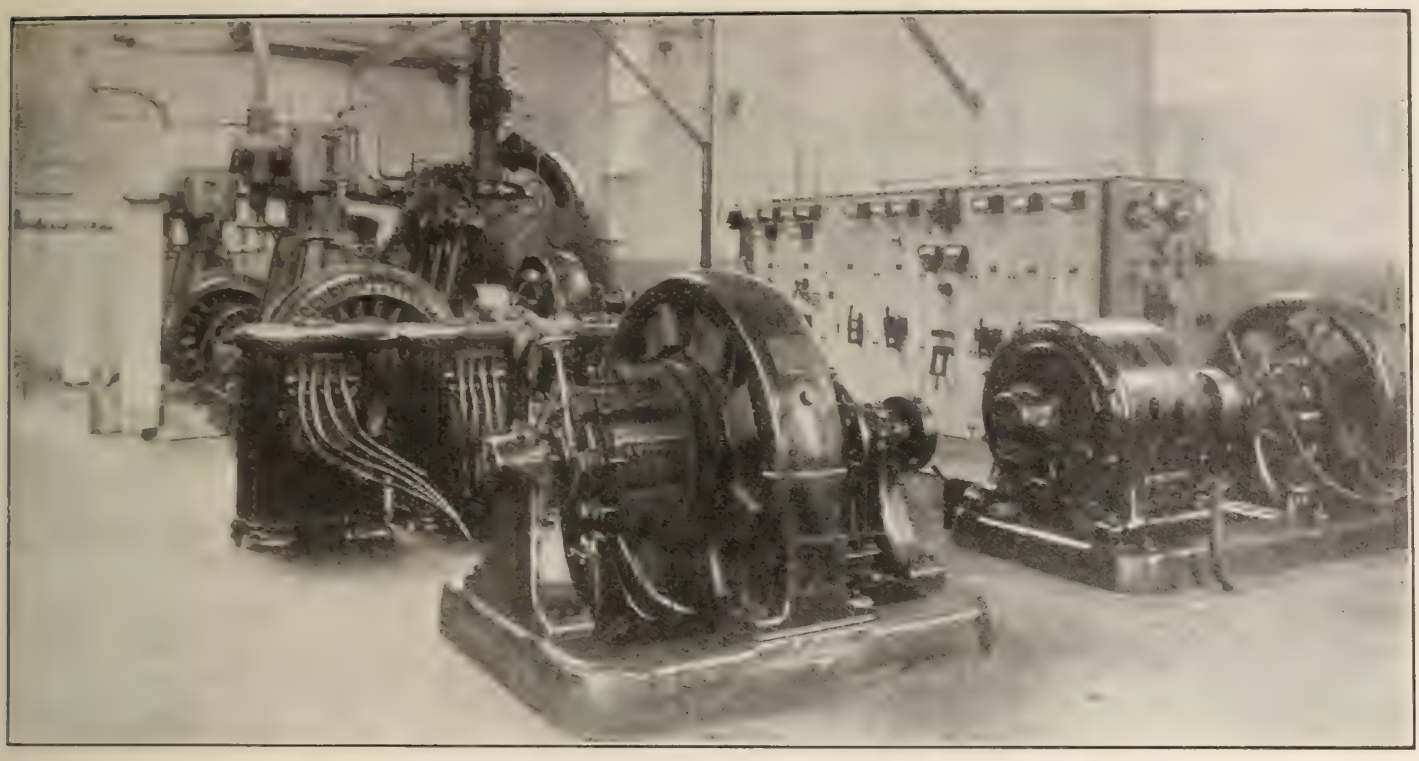


Fig. 1 -Montreal Steel Works Power House Electrical Generation, Transforming and Condensing Apparatus.

Power Plant Equipment---The Montreal Steel Works, Ltd

By Halyard

There is Here Described the Provision Made by one of Our Prominent Canadian Manufacturing Corporations Against Frequent and More or Less Crippled Output, Through Shutdown from Dependence on a One-source Power Supply. A Wise Management Discerns the Advantages That Accrue from its Works Being Equipped to Give a Capacity Sufficiently Additional to That Receivable from a Public Utility Company, and in so Determining, the Montreal Steel Works Directorate Have, as Their Experience Shows, Enhanced the Earning Capabilities of the Plant.

ORDERS on hand demanding a 24 hour day capacity output, and being constantly added to ; dependent on a public electrical corporation for its main power supply ; positively unable to get more than a fraction of the latter between the hours of 3 and 7 o'clock each winter afternoon, the consequent necessity of sending men home, were reasons powerful to warrant immediate and effective action being taken by the Montreal Steel Works management in the direction of a remedy for a growingly desperate situation.

Works Development.

The history of the Montreal Steel Works is that of pre-eminently rapid progress and successful development, with the end, not yet.

Located originally on the south bank of the Lachine Canal between lower St. Etienne and St. Patrick Streets, just west of the Wellington Bridge and St. Patrick's Park, in a modest structure, some idea of its present extent may be gathered from the latest ground and buildings' plan Fig. 5. The power house as will be noted, is situated on the west side of St. Etienne and south of St. Patrick Street.

Power House Building.

The buildings designed by T. Pringle & Son, and erected by C. E. Deakin, under the direction and supervision of James S. Costigan, chief engineer to the former, are briefly described as follows.

The engine room faces on St. Etienne St. and has a frontage of 47 feet, with a depth of 64 feet. The boiler room is to the rear, and on its west side, is a continuation of the wall of the engine room. The latter is one storey high, and is spanned with three steel trusses each eight feet deep at centre, 14 feet from the floor.

The roof consists of 12 by 4 inch hollow tile blocks, set at 16-inch centres, and having a 4 by 4 inch concrete beam reinforced by Kahn bars between each row of tiles. On top ¼-inch thickness of cement mortar is laid and plastered smooth to take the roofing felt and gravel. The roof light placed in the centre of the span of the third bay from the street, is a 12 by 16 feet metal-hipped-skylight, glazed with wire glass.

The walls are of Laprairie plastic brick set in cement mortar. The windows, of which there are 10 in the engine room, have galvanized iron frame and sash glazed with wire glass. They are 4 feet wide by 10 feet deep.

The boiler room is 42 feet wide by 64 feet long, and its walls, like those of the engine room, are of Laprairie plastic brick set in cement mortar, resting on concrete foundations. Seven cast iron columns in the centre of its width are so arranged in the length direction, as to carry the boilers independent of the brickwork, and by means of steel column extensions, support and carry the steel roof beams.

The layout is arranged for seven boilers, although only 5 are at present installed. Seven steel coal hoppers tapering from seven feet square at top to 1 foot square at bottom, are fixed to and suspended from the roof beams.

The roof is of similar construction to that of the engine room except in the matter of the beams, which are placed at closer centres. A metal hipped sky-

light 9 feet wide by 25 feet long, placed along the wall adjoining the engine room, throws abundant light in front of the boilers. Four metal framed windows on the rear wall and another on the west wall complete the daylight scheme whereby all dark corners are eliminated.

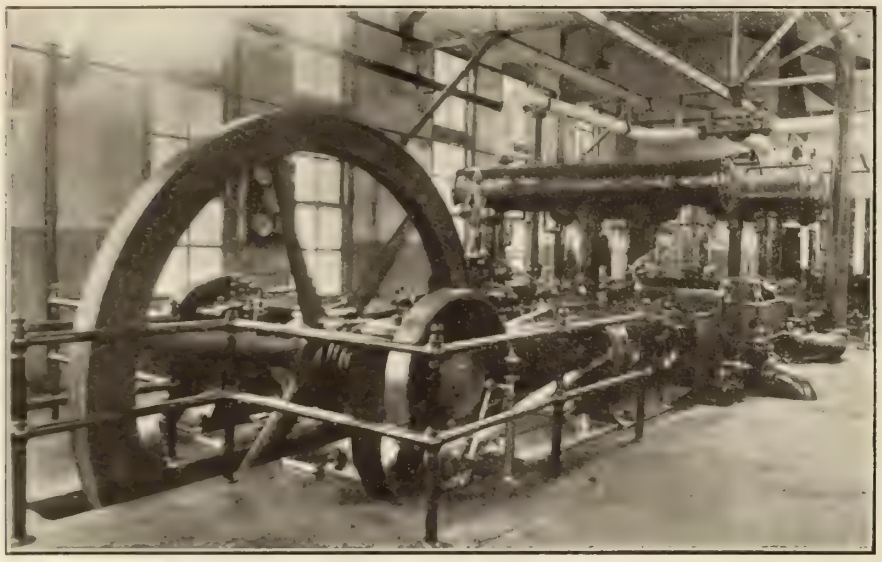


Fig. 2.—Montreal Steel Works' Power House, Air Compressor.

As the coal is carted up on to the roof by a run-way or ramp and dumped through openings over each coal hopper, a plank floor has been laid for the carts to drive on without risk of damaging the structure.

Both roofs are drained to central drainage hoppers with sheet lead flanges. Copper flanges were originally used, but did not stand the action of water which had been in contact with the coal, for the reason that the latter contained a considerable quantity of pyrites.

The floors are of concrete with granolithic finish, the contractors being Swan & Church, Montreal. Communication is had between the engine and boiler rooms by means of two 3 feet doors, having standard fire protection.

Natural draft only is used with the boilers and is obtained by means of a radial brick chimney, 5 feet 3 inches diameter, at the top and 125 feet high. The chimney is built on a concrete foundation, and has its lower 25 feet of Laprairie plastic brick, set in cement mortar. A 4-inch radial brick lining is separate from the main wall by a 2-in. air space, and the remainder of the chimney consists of hollow radial molded blocks. The contractors were the Adolphe Custodis Co., New York, according to whose system of construction the chimney was built.

Boiler Room Equipment.

Five return tubular boilers, each 66 inches diameter by 16 feet long; Murphy stokers fed by trunks leading from the hoppers already referred to; Foster superheaters in the rear smoke chambers, arranged to give 150 degrees superheat to the steam generated of 120 pounds working pressure, and a full expansion provision in the piping layout, constitute the leading features of the boiler room equipment. Fig 3 is a view of the boiler room showing the stokers, coal hoppers and trunk feed arrangement. Fig. 4 shows the layout on top of boilers towards the rear, of the saturated and superheated steam piping details.

Figs. 6 and 7 show longitudinal sectional and end elevations of the boilers, on each of which are to be seen in dotted lines the carrier columns with brackets underneath the boiler lugs.

Engine Room Equipment.

The electrical generating sets consist of three Belliss & Morcom 200 h.p. vertical compound double crank enclosed self-lubricating engines running 420 r.p.m., 2 Canadian General Electric and 1 Electric Construction Co., 140 k.w. machines with 4 pole, 7½ k.w. 1,425 r.p.m., 125 volt, belt driven exciters. Other electrical apparatus installed, consists of one 8 pole, 150 k.w. 250 volt rotary converter, three 60 cycle, 60 k.w. 575-185 volt transformers, one motor-generator set, one switchboard, made up of 3-140 k. w. generator panels, one transformer incoming line panel, one A.C. rotary converter and transformer panel, 1 D.C. rotary converter panel, one small rotary converter starting panel and 3 A.C. feeder panels for motor circuits. An installation of Nernst lamps supplied by the Canadian Westinghouse Co., takes care of the lighting in both engine and boiler rooms.

Motor drives form a feature of the works machine equipment and compressed air is largely utilized for light hoists, portable and hand tools. To provide for these latter, a Canadian Rand cross-compound Corliss steam and air cylinders, Corliss low pressure and pocket high pressure air compressor is installed. The steam cylinders are 14 and 26 inches diameter by 36 inches stroke, and the air cylinders 15 and 24 in. diameter by 36 in. stroke. Running at normal speed this machine has a free air capacity of 1790 cubic feet per minute at 100 pounds pressure.

Fig. 1 shows the west half of the engine room with the rotary converter, motor-generator set, switchboard and

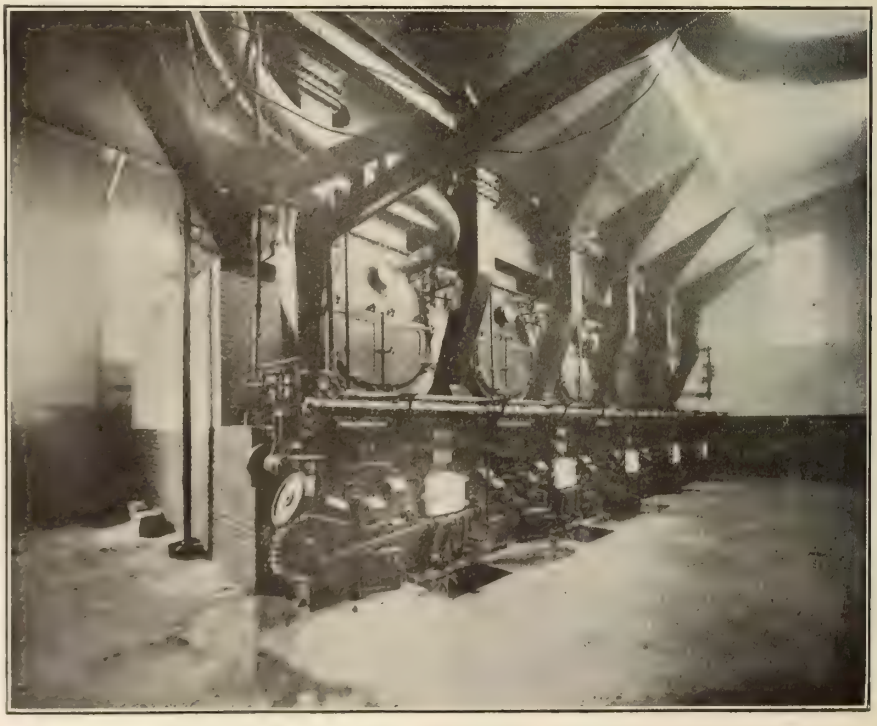


Fig. 3.—Montreal Steel Works Power House Boiler Room, Showing Murphy Stokers.

transformers in the foreground, and two Belliss and Morcom engines, pumps, condenser and atmospheric exhaust in rear. Fig. 2 shows the east half of the engine room with the already described air compressor in the foreground. The air inlet to the compressor is piped from a fine mesh cage on outside of the engine room roof.

An air receiver 42 inches diameter by 10 feet high, with safety valve set at 100 pounds pressure is located in the engine room close to the air compressor, and from it a 6-in. wrought iron flange pipe passes underground to another air receiver in the fettling shop on corner of St. Patrick and St. Etienne Streets, from which distribution to the whole works thereafter proceeds. This air pipe line follows approximately the line of the condensing water piping from and to the canal.

The condensing apparatus consists of a Belliss and Morcom surface condenser, centrifugal circulating and geared air pump driven by a 25 h.p. B. and M. single crank enclosed self-lubricating engine, running 525 r.p.m., Fig. 1 gives a general idea of the condensing apparatus, and shows the exhaust pipe connection with a shut-off gate on the lower side and atmospheric automatic valve on the upper.

The exhaust pipes from the various engines are carried in trenches under the engine room floor, and lead into an entrainer at the lower end of the vertical exhaust pipe behind the condenser. The condensing water supply comes from the canal and is returned thereto by 14 inch cast iron bell and spigot piping, laid below the frost line and indicated on Fig. 5.

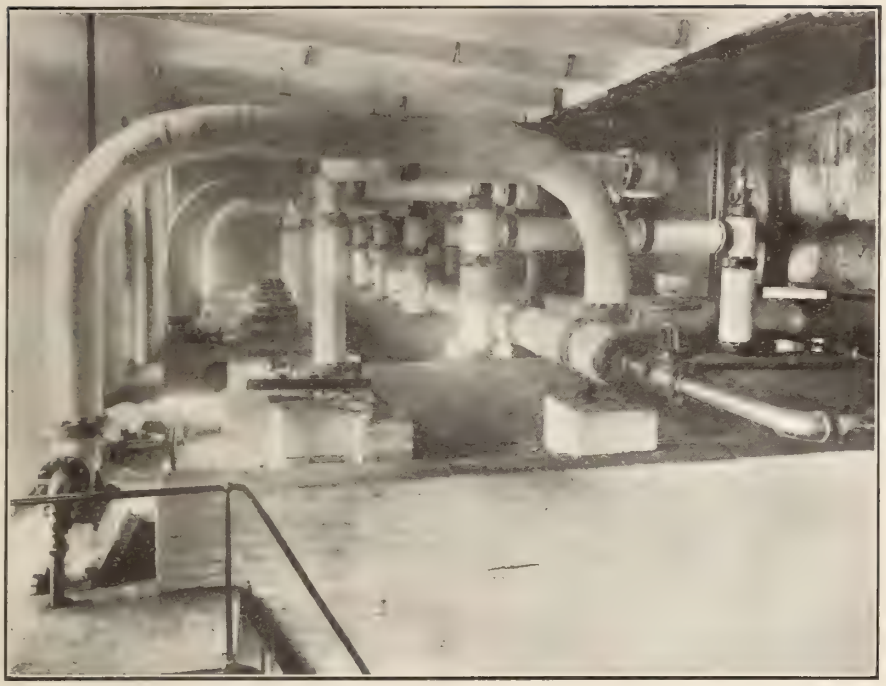


Fig. 4.—Montreal Steel Works Power House Expansion Arrangement of Steam Piping over Boilers.

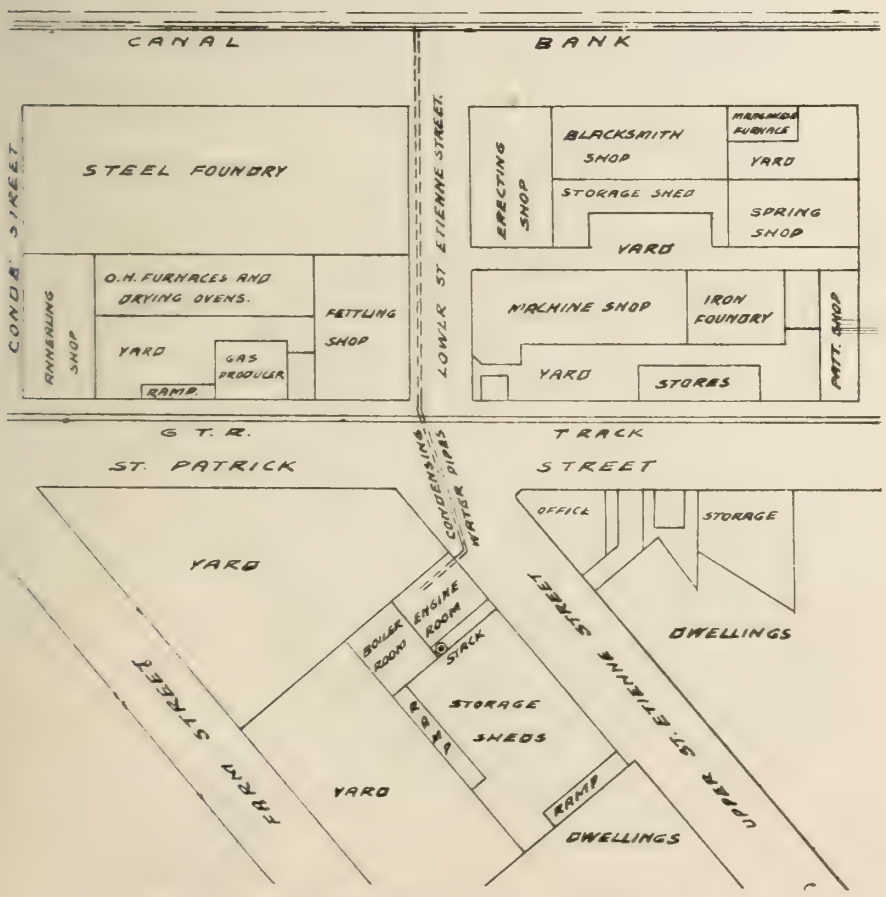


Fig. 5.—Montreal Steel Works, Ground and Building Plan.

The feed pumps, of which there are two, and the feed water heater, are the Burnham and Webster types respectively, manufactured by Darling Bros., Montreal.

Boiler Specification Extracts.

Each boiler to be 66 in. mean internal diameter, 14 ft. 1 inch long over front and back heads, and 16 ft. 1 inch long over back head and front extension shell. The upper side of top row of tubes must be not less than 24 inches from inside top shell, and no tube to be nearer shell than 3 inches.

The vertical rows of tubes on each side of centre line of boiler to be 6 inches centre to centre; free access to all parts of the boilers for cleaning purposes is required, and a standard size manhole is to be provided on top of shell, and on front head under tubes.

The shell and tube plates to be of $\frac{1}{2}$-inch uniform thickness Dalzell best steel, or its equivalent; all plates to have a tensile strength not exceeding 60,000 and not less than 55,000 lbs. per square inch.

Tubes.

To be of seamless cold drawn make, of the standard thickness, 14 ft. 1 inch long, $2\frac{1}{2}$ inches in diameter and properly distributed in the space allotted by the above mentioned distances from the shell of boiler.

Staying.

All parts of the boilers are to be made strong enough to bear a constant working pressure of 130 lbs. square inch for twelve years.

The rivet section where attachment is

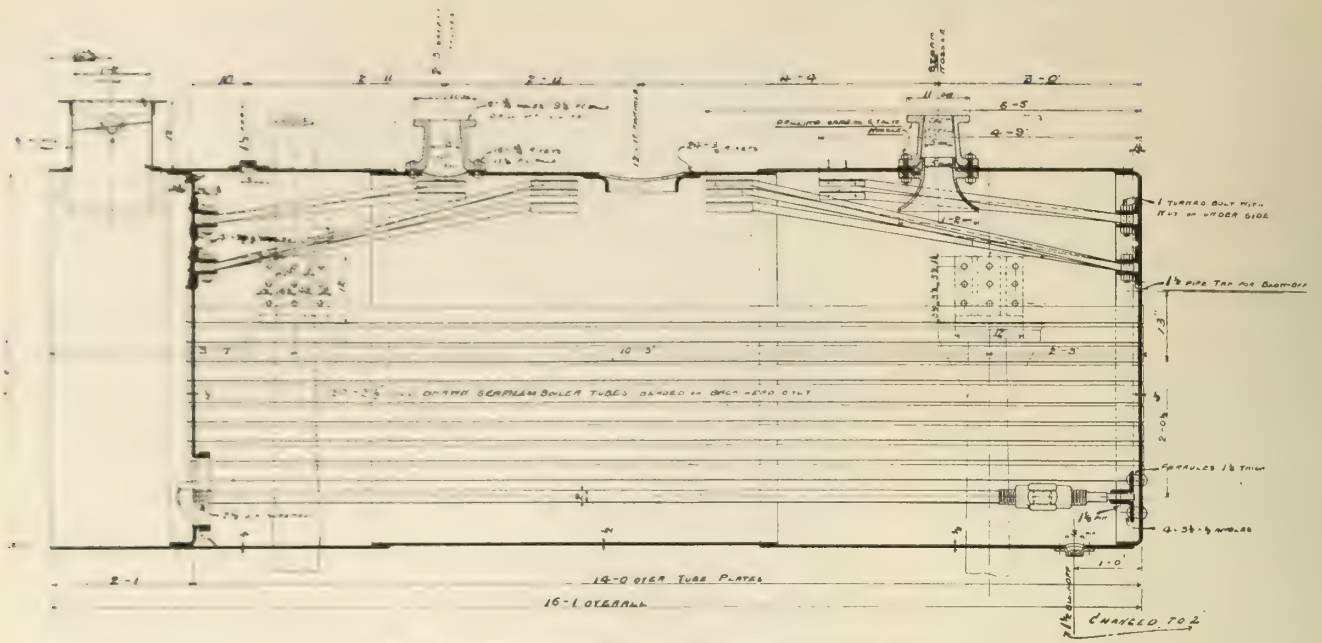


Fig. 6.—Longitudinal Section of Return Tubular Boiler.

made to shell and heads, must be in excess of that of the stay section.

Rivetting.

The shell to be riveted on all longitudinal seams, in accordance with the Rules dictated by the British Board of Trade and Municipal By-Law No. 108, with suitable rivets to form a joint of not less than 85 p.c. of the strength of the solid plate.

The ring seams to have not less than 56 p.c. of the strength of the solid plate.

Hydraulic riveting is required throughout.

Manhole Openings.

To be 16 by 12 inches clear, each end to form one-half of a true circle, 12 inches diameter. The shell opening to lie around the boiler with its greater axis, and to have a pressed steel plate compensating ring of ample section, curved to circle of boiler and securely riveted to inside of shell.

Pipe Connection Nozzles.

Each boiler to have two 5 inch inside diameter steel nozzles riveted to top of shell, for steam outlet and safety valve.

Testing.

The boilers to be tested to 240 lbs of water pressure per square inch, boilers resting on lugs and brickwork before the brickwork is too far built to interfere with proper inspection; the whole to be to the satisfaction of Mr. E. O. Champagne and the company's inspector.

Mountings.

All mountings, comprising safety valve, stop valves, blow off cocks, steam gauges, try cocks, water gauges, etc., will be furnished and fitted by the contractor on the boilers.

Contractors furnishing the new boilers to make good and repair all damages caused while handling and removing and setting said boilers on their respective foundations. The boilers to be delivered — days from date of order and placed on their foundations with no extra allowance of any kind.

Payment.

The payment to be in three different instalments, one-third on full delivery of total materials ; one-third at the first successful water test, and the rest on presentation of Mr. E. O. Champagne's certificate.

The layout of the machinery and its installation was carried through by the engineering staff of the steel works ; the Belliss and Morcom engines, condensing apparatus and superheaters were supplied by Laurie & Lamb, Montreal ; the boilers, smoke connection, coal trunks, exhaust piping and air receivers by the John McDougall, Caledonian Ironworks, Montreal. Much satisfaction has been had from the continued successful operation of the whole equipment.

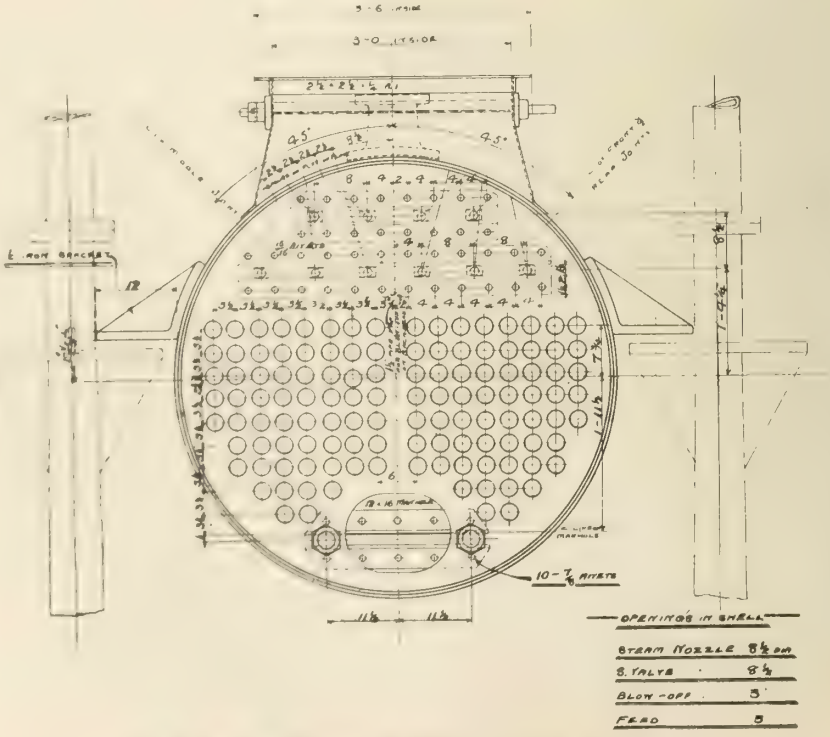


Fig. 7. End Elevation of Return Tubular Boilers.

Miniature Plant of the Point du Bois Power Plant near Winnipeg.

Canadian Water-Power Development

By Gordon C. Keith

"White Coal" is Receiving a Great Deal of Publicity at the Present Time. There is Much Political Talk and Many a Newspaper Story on "Cheap Power," but in Order that Some Authentic Information on the Subject, including Developed and Undeveloped Canadian Waterpowers May be Obtained, the Writer Has Collected Authentic Data on it Which is Included in This Article. In the Article, also Are Included Figures on the Developed Water-Powers, Transmission of Power and Costs to Consumer, etc. The Method of Charges Vary in Different Centres, the Different Systems Being Described.

ONLY a few years ago there were not many hydro-electric plants in Canada, those developed being to run grist and small mills. The availability of cheap power is an asset to any industrial centre. This has been recognized and many water-powers have been developed, until at the present time there are probably 600,000 h.p. developed by Canadian hydro-electric plants.

Of this 600,000 h.p. about 100,000 h.p. have been developed between the Great Lakes and the Pacific. Allowing 20 tons of coal per h.p. year, 5,000,000 h. p. of the West's available supply would represent a coal supply of over 100,000,-000 tons per year.

J. B. Challies, C.E., of the Department of Interior, Ottawa, gives the following table of Canadian water powers:

Location	Minimum flow development h.p.	Present development h.p.
Yukon	470.000	.....
British Columbia	2,065,500	73,100
Alberta	1,144,000	1,330
Saskatchewan	500,000	.....
Manitoba	504,000	18,000
Northwest Territories	600,000	.....
Ontario	3,129,168	331,157
Quebec	17,075,939	50,000
New Brunswick	150,000	.....
Nova Scotia	54,300	12,300
Total	25,682,907	516,887

This table is more or less of an estimate, which at most is very vague. In Quebec 9,000,000 h.p. included in the estimate, is in Labrador. In Ontario the estimate is extremely low as Niagara Falls alone has a potential power of 2,500,000 h.p.; Long Sault Rapids on the St. Lawrence 2,500,000 h.p.; along the G.T.P. in Ontario 2,-000,000, and in addition all the water powers on the Ottawa, Rainy, Kaministiqina rivers, etc. The estimate may therefore be considered low both for developed and undeveloped water powers.

All unalienated water powers in Manitoba, Saskatchewan, Alberta and North-West Territories are controlled by the Federal Government and are leased upon conditions of development and continuous usage. In the Yukon, too, the water powers are controlled by the Dominion Government and are leased for twenty year periods upon conditions of development, the price of power and its distribution remaining under the control of the commissioner of the Yukon territory. In British Columbia, as in Ontario, the title of water powers is vested with provincial not Dominion authority, but the title to powers in the railway belt is vested with the Dominion, that question having been settled by Privy Council decision of November, 1910. This will doubtless apply also to the water powers in the million and a half acres of land in the Peace River district of B.C. which that province granted to the Dominion.

The Conservation Commission is seeking to have enacted a measure which has for its object the conservation of the water powers of the Dominion for the benefit of the general public. It proposes that no power can be secured except by way of lease for fifty years When an application is made it will be referred to the conservation commission, and the lease will be sold by auction. Five years before the lease expires the government will give notice to the lessee of the terms upon which it will be renewed, and if the lessee does not accept, the lease will then be sold and the former indemnified for the improvements which he may have made. If the conditions imposed by the government are not fulfilled by the lessee the water powers will be forfeited to the government

British Columbia.

It is stated that on Vancouver Island alone, 500,000 h.p. could be developed. In addition to the B.C. Railway Company's activity at Jordan River, there is likely to be a development at Campbell River and also in the Alberni district. Power for Victoria is generated at Coldstream, twelve miles north of the city where 4600 h.p. is developed with Pelton water wheels operated under a head of 650 feet. Direct connected to these wheels are C.G.E. Company's generators of 1,200 k.w. capacity, with all necessary switchboard equipment and control apparatus. Four banks of air-blast transformers, having a total capacity of 2,400 k.w., raise the generated voltage from 700 volts to 17,500 volts, which is the pressure used in transmitting the power over two three-phase circuits on a single pole line to Victoria.

The B.C. Electric Ry. Co. is spending $1,500,000 on the Jordan River developments. Work was started in Oct., 1909. The initial power house equipment will consist of one 6,000 h.p. Doble water wheel, manufactured by the John McDougall Caledonian Iron Works, Montreal, operated under a head of 1,-150 feet. Connected to this wheel, and on the same shaft, will be a 4,000 k.w. 60 cycle 3 phase 2,200 volt A.C.B. generator. Oil insulated water cooler step-up transformers, 4,200 k.w. capacity, with switchboard and control apparatus, are supplied by the C.G.E. Power will be transmitted to Victoria over two 3-phase circuits on a single-pole line with metal cross arms and suspension insulators. Aluminium cable conductors will be used. The ultimate capacity of the plant will be 24,000 h.p.

Mackenzie & Mann interests, in connection with The Canadian Collieries are planning to create 50,000 electrical h.p. by utilizing the falls on the Puntledge River, at a cost of about $1,000,000.

On the mainland in British Columbia

the chief power is that of the B.C. Electric Ry. at Buntzen on Burrard Inlet, 16 miles from Vancouver. The whole plant is capable of producing 50,000 h.p. The power house to-day produces about 32,000 h.p.

The same company is planning the development of about 100,000 more h.p. from Jones Lake and Chilliwack Lake. The estimated cost of developing this water power is $10,000,000 spread over the next ten years. It includes the driving of a tunnel 14 by 16 for five miles, and the construction of a flume 10½ miles long. The water from these lakes is to be conveyed to a common point on the Fraser River.

At Revelstoke on the Illicillewaet River is a municipal water power plant. A gas plant has been installed to furnish power when the severe frazil and slush ice conditions make it necessary to have an auxiliary plant. Developments are also contemplated near Prince Rupert.

The Western Canada Power Co., is a $5,000,000 corporation which took over the Stave Lake Power Co., the plant of which is 100,000 h.p. Two units of 13,000 h.p. each are being added. The Powell River Paper Co., is spending $2,000,000 at Powell River on its plant. On the Adams River above Kamloops is another site. At Bonnington Falls on the Kootenay River $350,000 is being spent. There will probably soon be developments also on the Pend d'Oreielle, Willow and Katahda rivers.

At Calgary the Calgary Power Co has a modern plant under construction at Horseshoe Falls on the Bow River about 50 miles. The plant will cost $1,500,000 and includes two generators of 2,500 k.w. each, two of 4,000 k.w. each, the total water turbine capacity being 19,500 h.p. The power will be transmitted at 12,000 volts to Exshaw and at 55,000 volts to Calgary.

At Edmonton, which is in a coal field, power is generated by steam and power is sold at 3½ cents per k.w. hr., and to small users at a sliding scale up to 7½ cents per k.w. hr. Grand Rapids on the Athabasca River has a potential energy of 100,000 h.p., as well as Strathcona and other centres. On the Saskatchewan River, 72 miles distant is another falls which will probably be developed by lumber interests. The surplus power could easily be transmitted to Edmonton and Strathcona.

Saskatchewan.

Prince Albert has under construction a water power plant at La Colle Falls, 25 miles distant. At present 3,400 h.p. is being developed, making the cost of power $25 to $35. The falls will permit a development of 20,000 or 22,000 h.p., which when developed, will reduce the cost of power to $18 for large users.

At Saskatoon, the Saskatchewan Power Co., are erecting a plant on the Saskatoon River, 14 miles down the river. At Regina is a steam plant, the cost of power being 4½ to 7 cents per k.w. hr. for power. At Moose Jaw the cost is 7 cents per k.w. hr. with discounts of from 5 to 40 per cent.

Manitoba.

Brandon has been offered power at $25 per h.p. by the Chamberlain Power Co., and also Western Light and Power Co. The Reese Engineering Co. offered it at $22. The Reese Engineering Co. propose developing a waterpower on the Winnipeg River to supply Brandon, 258 miles; Portage la Prairie, 180 miles, and St. Boniface, 125 miles. The available power at Norman Dam is 30,000 h.p.

The Winnipeg plant was described in a recent issue of The Power House. The power plant is at Point du Bois on the Winnipeg River, 77 miles northeast of Winnipeg. The total available power without storage is 60,000 h.p. Machinery is now being installed for 20,000 h.p., the five turbines each using 75,000,000 gallons of water every 24 hours.

Ontario.

It is impossible in a short article to mention more than a few power plants and in Ontario the writer will refer to a few typical plants and take up some of the difficulties met and some of the plans followed such as the export of power, conservation of water powers, etc.

One thing that should be guarded against is the giving away of waterpowers. Ontario and Quebec have taken steps for the guarding of water powers by renting them for a term of years.

The Dominion water powers are given by lease for 21 years renewable until 84 years when it is cancelled. The license states the minimum of power

SCHEDULE A—TORONTO HYDRO-ELECTRIC RATES.

Alternating Current. 3 Phase---25 Cycles---13,200 Volts.

FLAT RATE.

Rate Per H.P. Per Month	Corresponding Rate per Annum	Minimum Monthly Bill.	H.P. Demand Allowed.
$2.29	$27.50	$344.00	300
2.12	25.00	425.00	400
2.02	24.30	506.00	500
1.96	23.50	588.00	600
1.87	22.50	750.00	800
1.82	21.90	912.00	1000
1.76	21.70	1075.00	1200
1.76	21.10	1320.00	1500
1.72	20.70	1725.00	2000

NOTE.

The [illegible] upon the highest peak of [illegible] by curve drawing watt [illegible] minimum guarantee.

METER RATE.

[illegible]	Off Peak Rate Per H.P. Hour.	Minimum Monthly Bill	H.P. Demand Allowed.
[illegible] to Jan. 15	$.0071	$ 344.00	300
[illegible]	[illegible]	425.00	400
p.m.	.0062	506.00	500
[illegible]	[illegible]	588.00	600
Jan. 16 to Feb. 15	.0058	750.00	800
[illegible]	[illegible]	912.00	1000
Oct. 15 to Oct. 31	.0065	1075.00	1200
[illegible] to Mar. 1	.0054	1320.00	1500
5.30 p.m.-6.30 p.m.	.0062	1725.00	2000

NOTE.

The consumption will be measured by two integrating watt meters, one operating during peak hours and the other during off peak hours, being actuated by time switch.

COMBINATION RATE.

Min. Mthly. Bill.	H.P. Demand Allowed.	Rate Per H.P. per mth.	Off-peak Meter Rate	Peak Schedule Rate $.06 per H.P. hour
$1775.00	2000	$1.76	$.0054	Dec. 1 to Jan. 15
1320.00	1500	1.79	.0055	4.30 p.m.-6.30 p.m.
1075.00	1200	1.82	.0056	p.m.
912.00	1000	1.87	.0058	Nov. 1 to Nov. 30
750.00	800	1.96	.0060	Jan. 16 to Feb. 15
588.00	600	2.02	.0062	5.30 p.m.-6.30 p.m.
506.00	500	2.12	.0065	Oct. 15 to Oct. 31
425.00	400	2.29	.0071	Feb. 16 to Mar. 1
344.00	300	2.62	.0081	5.30 p.m.-6.30 p.m

INFORMATION.

1. The rates quoted are net.
2. Horse-powers intermediate between quotations will be charged at the higher rate and will carry a pro rata minimum monthly bill.
3. Term of agreement is five years, except in the case of unavoidable accident, Government interference or any other cause not reasonably within the Consumer's control.
4. The Consumer will have the privilege of changing the monthly guarantee within the limits of this Schedule, once during the first twelve months and thereafter at twelve-month intervals.
5. Service is to be taken subject to City By-laws governing the same.

which may be developed, the maximum which may be taken; rates charged are subject to the railway commission and may be readjusted every seven years. The rental paid to the government may be paid every 21 years. By these regulations no corporation can control a site and block the development of industries in any place.

By the act of 1898 by the Ontario Legislature, all water powers over 150 h.p. are leased by the government, (1) for a payment of an annual rental; (2) development of a specified quantity of power in a given time; (3) by supplying power to those requiring it; (4) rates regulated by the government, (5) full capacity to be generated if there is a bona fide demand for it. It will thus be seen that the Ontario and Dominion regulations are similar in their effect. This act was extended in 1907, making the Hydro-Electric Commission agent for the crown.

Conservation of Water Powers.

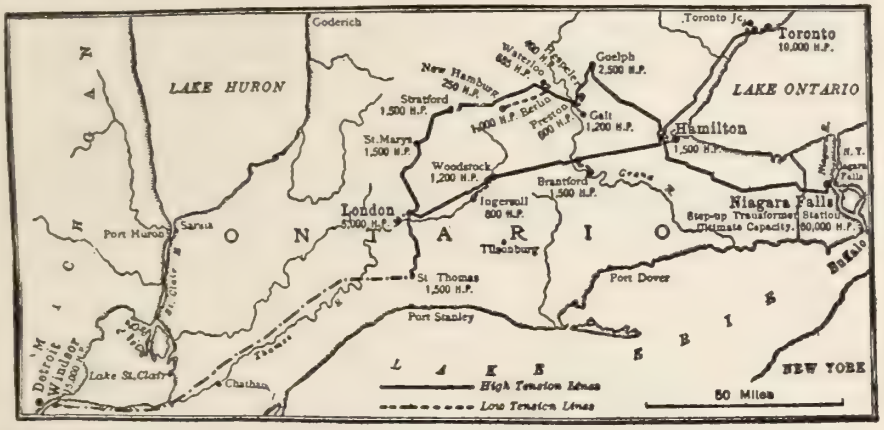
Ontario has already taken steps to conserve the waterpowers by setting apart as public parks the territory where a number of rivers have their source. These seven forest reserves or parks include (1) Algonquin, 1,930 sq. miles where the Petawawa, Madawaska, Muskoka, South, Magnetawan rivers, etc., have their source; (2) Timagami, 5,900 sq. miles, where the Montreal, Matabitchuan, Timagami, Sturgeon, Vermilion, etc., have their source; (3) Mississagi, 3,000 sq. miles, where the Mississagi rises; (4) Nipigon, 7,300 sq. miles, where the Nipigon and Sturgeon rises; (5) Eastern, 100 sq. miles; (6) Quetico, 1,560 sq. miles, where the Rainy River rises, and (7) Sibley, 70 sq. miles, making a total of 19,860 sq. miles.

A work that is being carried on by the Dominion government in Ontario is the conservation of the Ottawa by erecting large storage dams. Two of these works, at Kippewa and Temiskaming Lakes, will be finished during the present year, and one at Quinze Lake next winter. The waters controlled or retained by the dams will cover an area of 331 square miles, and the Ottawa river throughout its entire length to Montreal will, as a result, be given an even flow of water for power purposes throughout the year by the conservation of the spring floods. This high water will be let loose during the low-water periods of late fall and winter. This will obviate a recurrence of the power famine which recently crippled the big Chaudiere industries at Ottawa.

The Ontario Hydro-Electric distributing line will be operated at a pressure of 110,000 volts, but has been tested to 165,000 volts so that the progress of power transmission is pointing towards still higher voltages. So far as types of construction are concerned, the underhung insulator is being used on all of the 100,000 volt lines and, so far as line insulation is concerned, it seems to have been a very satisfactory solution to the problem.

Another method of construction that seems fairly well established is the use of steel transmission towers and long spans. In practically all recent high-voltage transmissions this form of construction is being used. It is particularly adaptable to rough country, where the spans can be designed so as to leap from hill to hill, and thus avoid the expense of carrying the lines into deep cuts or inaccessible gulches.

The transformer designer is probably the one who has the least to fear from the continual increase in transmission voltages. Cases of transformer breakdown are exceedingly rare in modern transformers, thus showing that the modern methods of insulation, particularly the strengthening of insulation between turns, has been a complete answer to the transformer problem.



Territory covered by the Ontario Hydro-Electric Commission's south-western Transmission Line.

EXTENSION OF ONTARIO TRANSMISSION LINES.

The power transmission lines of the Ontario Hydro-Electric Commission are to be extended from St. Thomas to Walkerville and Windsor, a distance of 128 miles, with a substation at Chatham, at a cost of $2,000,000. Provision has been made for Windsor to export power if it can be sold.

The Hydro-Electric Commission have an optional contracted with the New York & Ontario Power Co. for 15,000

The Proposed and Constructed Power Lines of the Electric Power Co. in Eastern and Central Ontario.

h.p. and if the eastern municipalities desire it, power will be supplied to Napanee, Kingston, Lansdowne, Brockville, Lyn, Prescott, Cardinal, Morrisburg and Athens, the members of the Eastern Municipalities Power Union.

The following prices will be paid by the commission: 2,000 h.p. or over, $13; 4,000 h.p., $12.50; 6,000 to 10,000 h.p., $12; over 10,000 h.p., $10.50

The Middle of Three Falls at Smith's Falls, Ont.

Three schedules of rates for the eastern municipalities were given, (1) amount of h.p. asked for, (2) if an increase of 50 per cent. is taken and (3) if 100 per cent. increase is taken, as follows :—

	H.P.	(1)	(2)	(3)
Kingston ..	1,500	$29.45	$23.76	$15.20
Napanee	200	29.23	28.44	22.09
[illegible]	500	55.38	34.13	26.81
[illegible] ..	1000	20.40	17.49	15.37
[illegible]	100	22.43	18.83	16.31
Prescott .. .	500	18.17	15.86	13.50
Cardinal .. .	300	16.18	14.50	12.90
[illegible] .	2000	16.18	12.03	11.67
[illegible]	75	30.07	30.05	24.60

The rates are somewhat higher than in Western Ontario but the cost of transmission is cheaper on account of the shorter distance. The Hydro-Electric Commission are also negotiating with the Electric Power Co. to supply Gananoque, Picton and other places in that vicinity. The Commission has also closed a contract with the Simcoe Power Co., near Midland, for 1,600 h.p. to supply Midland, Penetanguishene and Waubaushene.

Ontario Power Companies.

The Niagara power companies developing power from the Canadian falls are: (1) the Ontario Power Co. and Ontario Transmission Co., (2) Toronto and Niagara Co. (the Electrical Development Co.), (3) the Canadian Niagara Power Co., and (4) the Niagara Falls Power Co., all operating at 3-phase 25 cycle.

The Dominion Power and Transmission Co. have a plant at DeCew Falls and five transmission lines, (1) St. Catharines, 10,000 volt; (2) Thorold, 10,000; (3) Welland, 20,000; (4) Hamilton and Grimsby, 45,000; and (5) Brantford, 45,000 volts. They have a steam plant at Hamilton of 2,800 k.w., and one at Brantford 300 k.w., an hydraulic plant at Brantford of 600 k.w., one at St. Catharines of 200 k.w., and a development at DeCew Falls of 28,800 k.w., making a total of 32,700 k.w. The companies controlled are the Dundas Electric Co., Hamilton Electric Light & Power Co., Lincoln Electric Light & Power Co., Western Counties Power Co., Brantford Electric & Operating Co., Hamilton Terminal Co., and Welland Electric Co.

Fort William and Port Arthur are supplied from Kakabeka Falls on the Kaministiquia river by the Kaministiquia Power Co., from whom the Hydro-Electric Power Commission have arranged for power. It is transmitted 20 miles at 25,000 volts 60 cycles and sold to consumers at $25 per h.p. The present capacity of the plant is 15,000 h.p., but this will be doubled this year.

Among other important developments are those on the Ottawa near Ottawa City. Power in Ottawa is $12 up limited; $25 A. C. and $30 D. C.

Along the line of the Trent Valley canal are a number of power developments, chief of which is the new power plant of The Seymour Power & Electric Co., at Campbellford. The merging of these power developments under a holding company, known as The Electric Power Co., has recently been announced; and extensive plans for the distribution of power to all sections of this district are under way. The following companies are now all subsidiary to the holding company, The Electric Power Co: The Seymour Power & Electric Co., The Peterborough Light & Power Co.; The Peterborough Radial Railway Co., The Auburn Power Co., of Peterborough, The Trenton Electric & Water Co., The Sydney Electric Power Co., The Nipissing Power Co., Oshawa Electric Power Co., The City Gas Co., of Oshawa, Cobourg Utilities Corporation, Northumberland-Durham Power Co., Central Ontario Power Co.

Power for Mines.

The Cobalt power plants have been described in The Power House, and also the developments of the Huronian Power Co. The Cobalt Hydraulic Power Co. have a development at Ragged Chutes on the Montreal River. A Taylor hydraulic compressor has available 5,500 h.p., compressing 40,000 cu. ft. of free air per minute at a pressure of 120 lbs. per sq. in. It is sold for 25 cts. per 1,000 cu. ft. and 100 lbs. pressure. The smaller users are charged for 1 drill, $5; for 2 drills, $4; for 3 drills, $3.50; 4 drills, $3.10 and 5 drills, $2.83. There are 400 k.w. generated and sold to the Cobalt Power Co.

The Cobalt Power Co. develop 4,395 h.p. The power is sold on a meter or at $50 per annum. At the Mines Power Company's plant on the Matabitchuan River, 23 miles south-east of Cobalt, the system of water storage is a feature. There are 7,500 k.w. generated. In each of the sub-stations at Cobalt and Brady lakes, are two air compressors, each developing 5,000 cu. ft. free air per minute, electrically driven. It sells at 24 cts. per 1,000 cu. ft. at 100 lbs. pressure. Power sells at $50 per h.p. It thus appears that it is cheaper to develop electrical power and transmit electrical energy afterwards compressing air than generating compressed air and transmitting it. Of course for very short distances the reverse would be true.

The Huronian Power Co. have a development at High Falls on the Spanish river, supplying power to the mines of the Canadian Copper Co. The Lorne Power Co. develop 1,500 k.w. on the Wabageshik Falls on the Vermilion River for the Mood Nickel Co. The Sudbury Power Co. generate 1,000 k.w. at McPherson Falls on the Vermilion river. The Wahnapitae Power Co. transmit power from 9 miles south-east of Sudbury on the Wahnapitae river to Garson mine and Moose Mountain Iron Mine. The Algoma Power Co. at High Falls on the Michipicoten river, supply the Michipicoten district, including the Helen iron mine. The Black Donald Graphite Co. receive power from Mountain Chute on the Madawaska river, and the Deloro Mines from the Seymour Power Co.

In Northern Ontario there are numerous rivers, as a reference to a map of Ontario will show, among them be-

ing the Abitibi, Mettagami, Missinaibi, tributaries of the Moose River; the Kabinakagami and Ogoke, tributaries of the Albany and the English, Winnipeg and Rainy rivers. These rivers are rich in waterfalls. Including only falls capable of developing 5,000 h.p. or over, the available h.p. amounts to 2,000,000 h.p., which is probably a very conservative estimate made by L. V. Rorke, Inspector of Surveys, Department of Mines, Toronto. These water powers are so evenly distributed that it would be possible to electrify the G.T.P. and furnish power to any industries that may manufacture along that railroad in Ontario.

Quebec.

The large development at Shawinigan Falls, near Quebec, has been fully described in The Power House. It has transmission lines extending in all directions supplying power and light to the numerous cities, asbestos mines and pulp mills within the limit of its transmission lines.

The Canadian Power Co. have a 25,000 h.p. development on the Beauharnois Canal near Montreal, Sherbrooke and Lennoxville are supplied by the Sherbrooke Railway & Power Co. Sherbrooke has a municipal hydro-electric plant on the Magog river. The new plant of the Sherbrooke Railway & Power Co. is between the municipal plant and the St. Francis into which the Magog flows. Power aggregating 1,000 h.p. will be generated with the present plant 3-phase 60 cycles and transmitted by copper wire.

Along the Ottawa and Gatineau rivers on the Quebec side are falls which have a minimum capacity of 520,000 h.p. The average h.p. would probably be double this amount.

It will be noted in Mr. Challies report that Quebec has by far the largest available water power from known water falls. The total given is 17,075,939 h.p. Of this only 50,000 h.p. is developed showing the future possibilities in the development of power in Quebec.

New Brunswick.

One of the largest water powers in New Brunswick is at Grand Falls. Steps have been taken to develop this power and the new company recently completed is likely to carry on construction work to completion. The name of the new company is Grand Falls Co. It has a capital of $1,200,000, the incorporators including Sir William Van Horne; H. S. Holt, president of the Royal Bank of Canada; Geo. F. Underwood, vice-president of the International Paper Co., New York.

The Maine and New Brunswick Power Co. have a development at Aroostook Falls. They are making arrangements to extend its power lines to Limestone, Van Buren and St. Leonards running near Grand Falls. They will sell power and light for towns reached and probably power during the construction work at Grand Falls on the St. John.

A development is proposed to produce power on the St. John River, 40 miles above Fredericton, on the St. John River by the Electric Power Co.

Nova Scotia.

In all parts of Nova Scotia there are water powers well worth development which have not so far received attention. On other streams development is well advanced, and some few rivers, particularly the Mersey and St. Croix, are at present generating quite an amount of power, but not one of the streams has the development of its full power completed.

Nova Scotia streams have a deficiency of storage capacity, and to permit of the highest development artificial storage must be created on the watershed by placing dams across the stream, where possible and create reservoirs to hold back part of the flood flow.

W. G. Yorston, C.E., states that the flow of Nova Scotia streams in dry summer months will be found to be one-tenth and less of the flow in other months when the rain fall is heavier. If steam power were used as an auxilary to supplement the power in the months of small stream flow, the amount of power to be derived could be made much more constant. But the best power of all is one in which storage reservoirs and steam are both used to increase the amount of power, the ideal power being one with reservoir capacity to equalize the flow over not only a year but a cycle of years and thus obliterate the vagaries of the rain fall.

West Kootenay Power and Light Company's Power House No. 1. Bonnington Falls—Showing Lower and Upper Falls.

Factors in the Transmission of Power by Belting

By Pathfinder

An Illustrative Descriptive Article, Detailing Some Desirable Features to be Accounted in the Selection, Location, Application and Care of Belts, Belt Pulleys and Belt Drives, with a View to Attaining the Most Efficient and Economical Results.

THE overwhelming, universal and undiminished use of leather belting as a means of power transmission, stamps it at once a subject of interest, for one can hardly conceive of a factory without associating with it a belt drive.

Choice of Belt.

In the choice of a belt, the first consideration is that it be made from a good hide. Some indicative opinion may be had by cutting a thin shaving from the samples offered, and tearing them between the fingers. This will enable even the unskilled to form an opinion as to how much of his purchase is leather, and how much simply weight-making material.

Lubrication and Stretch.

Leather belts lose a good deal of their strength and nature unless impermeated with a certain amount of oil. Good quality cod oil is largely used for this purpose.

An ordinary belt thus lubricated, develops a stretching propensity, which is of course both troublesome and wasteful.

The problem, therefore, is to secure the admittedly advantageous features of "lubrication without stretch."

The solution is obvious—Stretch the belt fully before application

Strength of Belt.

The ultimate tensile strength of belting is not generally a factor in power transmission calculations. It may be reckoned at an average of say 3,500 pounds per square inch. This variation in ultimate strength is due not only to possible variation in the quality of the material, but to want of its homogeneity as well.

The ultimate strength of a laced joint well put together should be taken at from 1,000 to 1,500 pounds per sq. inch, while that of a riveted joint may be taken as equal to one-half of the strength of the solid belt.

Adhesion of Belts.

The motion transmitted by a belt is maintained solely by the frictional adhesion of the belt to the pulley rim. Belts do not communicate motion with precision on account of their liability to slip.

The adhesive grip of a belt is greater on wooden than on cast iron rims.

Slippage of Belts.

A belt will slip just as readily on a pulley four feet in diameter as it will on a pulley two feet in diameter, provided the conditions of the faces of the pulleys, the are of contact, the tension and the number of feet the belt travels per minute, are the same in both cases.

Causes of slippage are because belts are overloaded, dirty, clogged, dried up and neglected.

It stands to reason that while slip may be prevented by undue tightening, this is not the right method to make the belt do its full duty.

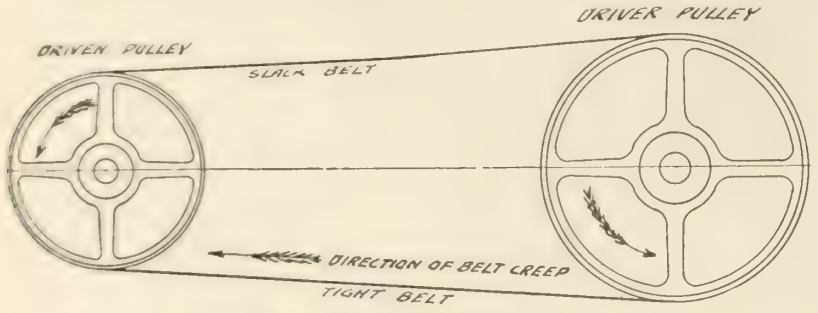


Fig. 1.—Horizontal Belt Drive.

A belt properly filled and of correct dimensions for its work, should break before slipping.

Preservation of Belting.

Engineers usually pay little attention to their belting except that which is giving immediate trouble.

The ingredients of a leather, cotton, or camel's hair belt, manila or hemp driving rope, slowly dry out and leave the contact surfaces hard. Unless something is added to replace these natural ingredients the belt or rope cannot be expected to grip the pulley close enough to transmit full load.

Creep of Belt.

By creep of belt is meant its stretching and contracting propensity as it passes over the pulleys, and is due to inherent elasticity and nature of load.

The net result is a continuous creep or shifting of the belt around the pulleys in a direction opposite to that in which the belt runs. Fig. 1.

Belt creep in practice is usually kept within a one per cent. limit, and to make certain of its attainment, the working strain for best material belt body and substantial joint is taken at 40 pounds per inch width single belt, 70 and 100 ditto for double and treble belts respectively.

Centrifugal Tension of Belts.

When a belt runs at a high velocity, centrifugal force produces tension in addition to that existing when the belt is at rest or moving at a low velocity. This diminishes the effective driving force.

Double belts are less pliable than single belts and the centrifugal force is greater. Furthermore, the tension is seldom increased proportionately; for these reasons, double belts should not be expected to transmit more than 8-5ths the power of single belts.

Horse Power of Belting.

Users of belting are frequently misled as to the amount of work which should be got from a good belt.

The power of belting is determined by the number of foot pounds which can be transmitted by one pulley to another, and is arrived at by multiplying the effective pull in pounds per inch of width by belt width in inches and by belt speed in feet per minute; thereafter dividing by 33,000.

The effective pull or the force tending to turn the pulley is the difference in tension between the slack and driving sides of the belt and is largely dependent on the arc of contact between the belt and the smaller pulley.

To find the effective pull it is necessary to determine the number of degrees in the arc of contact. This can be arrived at by multiplying the difference between the pulley diameters in inches by four and three-quarters, dividing the product by the distance between the pulley centres in feet, and subtracting the quotient from 180 degrees.

The allowable working strain for a single belt with 180 degrees contact is, 40 pounds per inch width. This multiplied by the arc of contact found in the previous calculation and divided by 180 will give the effective pull allowable in pounds.

Pulley Factors.

In determining what pulleys are best to use in any equipment, the factors of windage, weight, balance, belt contact, powerful compression to avoid keyseating of shaft, and convenience of handling should have prime consideration. A choice of pulleys which fulfills these re-

quirements may mean a somewhat high initial outlay, but will mean annually much reduced operating expense.

Comparison of Pulleys.

Pulleys as manufactured, are of cast iron, wrought iron, mild steel, wood and iron or steel in combination.

For good belt contact, minimum slippage, and least power absorbed without recourse to belt dressings to secure adhesion, the wood rim is to be commended.

It should of course be borne in mind that there are good and bad features in wood pulleys. Belt contact, reduced weight, and facility of handling, are generally speaking strong points in their favor, but unless at least the equivalent windage of a well-designed cast iron pulley be had, the other gains may be almost all offset. The properly designed wood pulley should be the equal of other types in their best features, and their superior otherwise.

Windage.

An absence of windage is not always a feature of wood pulleys.

The improvement necessary in the reduction or absence of windage in wood pulleys, lies in the arm attachment between rim and hub. The arms should be of a shape corresponding to those in cast iron or similar ; the material light, rigid reliable, and attached securely to rim and hub.

Arms of cold drawn seamless steel tubing, pressed into ribbed form, and forced into a taper hole on bosses of a malleable iron hub ; upset and beaded over on end, constitute a fastening, Fig. 2, which has come under the writer's notice as having much to recommend it.

The arm and rim attachment is housed within the rim, and consists of a saddle piece embracing the flattened end of arm, and fastened to it by steel pins driven into rim.

Belt Pulley Speeds.

The wood pulley has advantage over those of iron or steel, in that it can be run at a much higher speed.

As showing what can be done, a wood rim pulley with iron spider has recently been made and tested by the Dodge Mfg. Co., to run safely at five and one-half miles per minute.

Shaft Attachment.

The shaft attachment of pulleys is a matter of some importance, necessitating, as it does, the cutting of keyways, the use of set screws, or reliance on the compression of the bushing alone.

Cast iron pulleys invariably require keyseating of the shaft, the only exception being for very light loads. No keyseating means a reduction of outlay, a rapid convenient attachment, and an unimpaired shaft strength. It must not be forgotten that keyseating a shaft reduces its strength, and in the case of cold rolled shafting, is highly detrimental ; placing it inferior to turned shafting under the same treatment.

Hurry jobs call for easy yet effective fixings, and cold rolled shafting and keyless pulleys do much to help out awkward situations.

Hub Bushings.

Cast iron bushings with large bearing surface are best adapted for all pulleys because, when properly compressed, they exert a positive contact with the shaft. The adaptability to compression depends much on the elasticity of the hub material, and a malleable iron hub, light yet strong, seems to give with the cast iron bushing, results hard to surpass.

Influence of Pulleys on Belts.

The outer face of a belt travels faster than the inner, causing compression of the latter and extension or stretching of the former. This process has a naturally injurious effect on the substance and life of the belt and should be minimized to the fullest extent possible, by using large diameter pulleys, those especially with little crown.

Horizontal shaft pulleys should have about $\frac{1}{8}$-inch per foot crown, while those on a vertical shaft should have about twice that amount.

Installation of Belting.

In applying new belts, care should be taken that the proper side goes next to the pulley. Belts have what is known as a flesh and a hair face ; the former of which to the uninitiated might suggest itself as the driving face. This is not so, however, for the reason that the flesh face being tougher, is better able to stand the stretching already referred to, and the hair side which is predisposed to cracking, wears better under compression.

The top end of splices connecting the laps should point in the running direction of the belt.

Horizontal belts and angle drives up to 45 degrees from the horizontal plane, should have a sag of about $\frac{1}{8}$-inch per foot, and the underside be the driver.

Vertical belts should be pulled tight to ensure grip on the lower pulley.

Shafting and machinery should be so arranged that belts will run from the former to the latter in opposite directions to equalize the strain and pull on the bearings.

Increase of belt width should mean a corresponding increase in thickness, and it is probably true that a thick and narrow belt is more durable and works rather more satisfactorily than does one wide and thin.

Flapping of Belts.

Flapping of belts is due to a variety of causes, to which the following are the chief contributors ; the ends of the belt at the joint not being perfectly square, pulleys out of line and set at an excessive distance between centres, high velocity running which tends to trapping of the air between belt and pulley, thereby diminishing the adhesive contact.

Sudden and often occurring change of speed due to heavy intermittent machine load, invariably causes flapping of belt.

Trapping of the air may be counteracted by perforating the pulley rim or the belt.

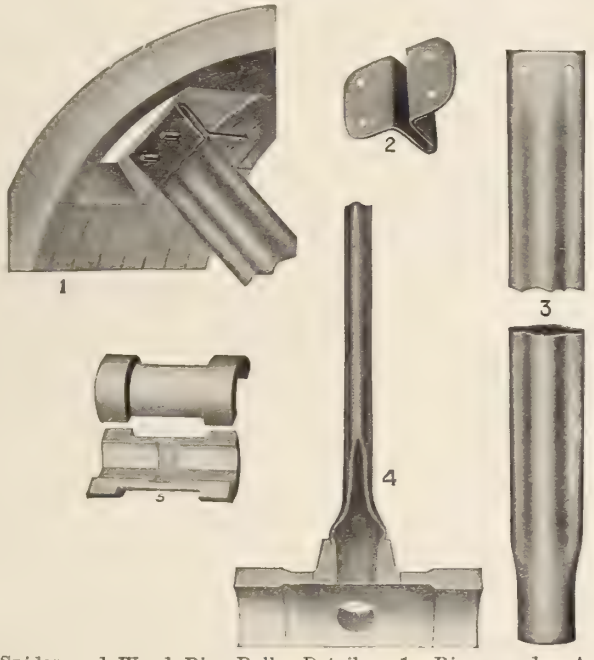


Fig. 2.—Metal Spider and Wood Rim Pulley Detail. 1.—Rim and Arm Connection. 2.—Saddle. 3.—Pressed Arm. 4.—Arm and Hub Connection. 5.—Bushing.

Care and Use of Belting.

Leather belts should be protected against water and other moisture by using a waterproof dressing. Belts made of coarse, loose fibred leather give best service in dry and warm places. For damp or moist conditions, the very finest and firmest leather should be used.

Oil should not be allowed to drip on

belts. Leather belting may not safely be constantly used above 110 degrees Fah.

Belt Joints.

It is preferable to joint the ends of a belt by splicing and cementing as it ensures against irregularity of running.

Laced belts should have the lace holes punched with an oval punch whose longer axis is parallel to the belt lengthways. Lacing should not be crossed on the driving face.

Conclusions.

As a result of modern experimental work on power transmission by leather belting, much light has been thrown on the subject. It appears proved that the greatest allowable belt tension is not constant, neither is the belt velocity even with pulleys revolving at constant speed.

The efficiency of a belt has been shown to be just as high as a good gear transmission; the loss in over-all efficiency being largely due to bearing friction, showing that the looked-for improvement should come from that quarter in the shape of ball or roller bearings equipment.

VALUE OF CLUTCHES IN TRANSMISSION SYSTEMS.

By M. E. D.

THERE are two chief objects in using clutches in the transmission of power, (1) to reduce consumption of power and (2) to reduce upkeep and maintenance of plant and therefore increase output. Savings may be made where any part of the shop or a machine is used only periodically. Instead of having a belt revolving and a line of shafting using up power continuously, the clutch eliminates the use of any power whatever. This use of a clutch is especially useful where it is necessary to work overtime. The part of the shop not required can be closed down by the simple operation of the clutch lever.

The writer worked in one shop where a long line shaft was extended from the machine shop to the foundry across a drive-way. Power was used in foundry for an hour or two in the morning for the tumbling barrels and for about the same length of time during the afternoon for the "heat." During the rest of the day the shafting, pulleys, etc., were running idle consuming power where a clutch would have saved this waste.

The same thing happened when the machine shop was running overtime, but in addition to the foundry shafting and pulleys revolving, all the lines in the machine shop were being operated whether the machines on all the lines were required or not. The cutting out of a department makes more power available for other departments.

Another case where a clutch is very useful is where a gas engine is used for power. Instead of starting up the engine and then mounting the belt at a great risk to the operator and destruction of the belt, a clutch may be used to throw the shafting into gear when the gas engine is running at full speed. Such an installation has been made at the works of the Gendron Mfg. Co., Toronto. The shafting is gradually brought up to speed by the frictions and the wear of belt and danger are eliminated.

EXHAUST STEAM TRANSMISSION.

An example of what may be accomplished with exhaust steam is shown by the work being done by the Monarch Supply Co., Toronto, of which G. D. Bly is chief engineer. This company heats thirty buildings besides supplying light and power. There are over 65,000 feet of heating surface, the highest point heated being 130 ft., the greatest back pressure being 3 lbs.

A vacuum system is used and in the various buildings are Webster float valve traps, those of the Canadian Steam Boiler Equipment, Webster thermostatic valve and the Dunham trap. All these various systems are successfully operated, the pump used in connection with the transmission of the exhaust system throughout the coils being Burnham design.

LARGE WATERPROOF BELT.

The Beardmore Belting Co., Toronto, recently installed in the Cornwall plant of the Canadian Cottons, Ltd., one of the largest waterproof cement leather belts yet installed in Canada. The belt is 40 ins. wide, 3 ply, and 175 ft. long. It is used for the main drive from the water wheels, in a wet place where leather belting was not used previous to this installation.

Apart from the largeness of the belt and the place in which it runs, the belt is the same as the extra waterproof cement belting which has been installed in a large number of sawmills, paper mills, tanneries, etc.

ALUMINUM VS. COPPER TRANSMISSION LINE.

The Hydro-Electric Commission have adopted the use of aluminum wire for long distance transmission as have also the Shawinigan Power Co. in Quebec. The conductivity of aluminum is only 62 per cent. of that of copper, but as an aluminum wire of equivalent conductivity of copper weighs only 48 per cent. of the copper wire, owing to the small specific gravity of aluminum which is 2.68 compared with 8.94 the s.g. of copper, it is advantageous for use where weight is a matter of importance. The strength of aluminum wire for equivalent conductivity exceeds that of copper wire by 60 per cent. The cost of aluminum, of course, is higher than that of copper, pound for pound, but it is cheaper for the same conductivity, provided bare wire is used.

When the wire is insulated, however, copper has the advantage on smaller sizes, because in wires of the same conductivity the circumference of copper wire would be so much less than the circumference of the aluminum conductor that much less insulating material would be required. This relation, however, holds true only within certain limits, for on larger sizes aluminum again becomes cheaper even with insulation, due to the fact that conductivity depends upon the cross-sectional area, and this latter varies as the square of the diameter and circumference. Hence it will be seen that in comparing the advantages of aluminum and copper for electric conductors, many factors must be considered, and the relative costs, carefully computed.

Beardmore Waterproof Cement Leather Belt, 175 ft. long, 40 ins. wide, for Canadian Cottons, Ltd., Cornwall.

What is the Force that Makes a Motor Operate?

By Fred. H. Moody

While the Care and Efficient Operation of Electric Motors are Understood by the vast Majority of Engineers, Many of Them, More from an Awe of the Subject, Rather Than From an Inability to Grasp its Princples, Do not Understand the Actual Operations of the Invisible Force That Propels the Motor. It is Very Simple in its Action, and Can in Many Ways be Likened to a Jet Turbine, the Energetic Fluid Jet Being Replaced by an Invisible Stream of Magnetism Whose Action is Much the Same. This is Explained in the Article.

THE experience of the writer has been that electric motors and generators are more or less of a puzzle to operating engineers, and that a certain air of mystery shrouds their operation. The same feeling seems to apply to everything electrical. In the case of the motor, engineers know that if two wires be connected to it, through proper starting boxes, etc., it will revolve, but the "how" of it is all a mystery. It is hoped that the simple discussion which

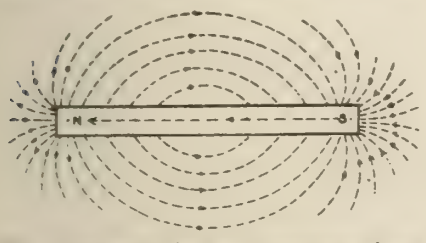


Fig. 1.—Magnetic flux as it emanates from a magnet.

is to follow, will help to clear that subject in the minds of many, and give them such a grasp of the fundamentals of the subject that they will be in such a receptive mood as to desire to pursue the subject further in some good text book—a matter which is impossible in the limited space here available.

Magnetism.

In the first place, it is necessary to know a little about magnetism. Being invisible, and also intangible, makes it more difficult to grasp what is implied when a substance is said to be magnetized. Magnetism is an invisible force, in the form of what are termed "lines of force," which act through a bar of magnetic material such as iron or steel; these latter are the most common magnetic materials. Nickel also, is capable of magnetization like iron or steel, but not so with brass and copper, which are termed non-magnetic. These lines of force are operated in the manner shown in Fig. 1, emanating from the magnetized bar into space, passing back through paths of varying length to the other end of the magnet through which they again pass. This is kept up indefinitely. While as before mentioned, they are not apparent to the visual organs, their existence can be readily proved by a simple experiment. For example, if a sheet of glass be placed over a magnet, and fine iron filings be sprinkled over it, and the glass plate be gently tapped, the filings will arrange themselves into the form of the diverging circles diagramatically shown in Fig. 1.

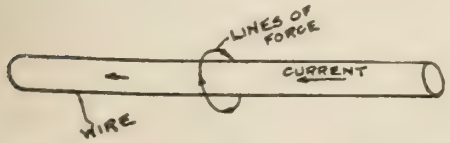


Fig. 4.—Manner in which lines of force encircle a live wire.

Now there must be some way of distinguishing the ends of the magnet, and the direction in which the lines of force flow. It is well known that the earth itself is a huge magnet, as is evidenced by the actions of a compass, the lines of force of the earth tending to keep the compass needle constantly in one direction. Now, as the ends of the earth-magnet are very near the geographical poles, the term "pole" is applied to the ends of a magnet, the terms "north" and "south" being applied in conjunction. The lines of force always flow in one direction with regard to the poles, i.e., from south to north through the magnet, and from north to south, out

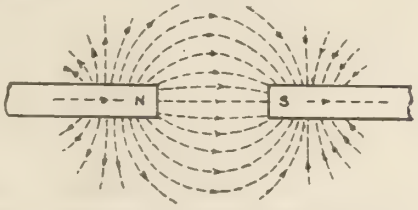


Fig. 3.—Magnetic field when two unlike poles meet—Attraction.

through space from the north pole to the south pole.

As the name "lines of force" imply, these invisible lines have power. If two poles of the same polarity be brought near together as in Fig. 2, the emanating lines crowd out against each other, mutually repelling each other. Also unlike poles attract each other, as shown by Fig. 3, the lines of force tending to run into each other, the magnets being mutually drawn together. This may be summed up in the following simple rule: Like poles repel each other; unlike, attract. This statement is extremely important, and should be memorized, as it is very essential to an understanding of motor operations.

Electro-Magnets.

As is generally known, the usual method of producing magnetism, is by passing a current through a coil encircling a bar of iron, which it magnetizes. The previous discussion dealt with what is termed a "permanent" magnet, that is, one that is magnetized permanently and requires no further external power to produce the magnetism. However, the action of electro-magnets is exactly the same, lines of force emanating in a precisely similar manner.

An explanation of how this magnetism is generated by electricity would clear up many of the early difficulties previously mentioned. When a current of electricity passes through a wire, lines of force are created which encircle the wire as shown by Fig. 4. These lines encircle the wire throughout its full length, and act at all distances from

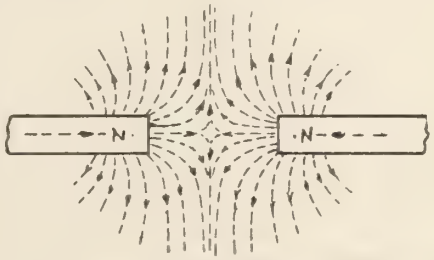


Fig. 2.—Magnetic field when two like poles meet—Repulsion.

the wire, though of course weakening very rapidly as the distance from the wire is increased. The presence of these encircling lines of force can be proved by a simple experiment. Hold a sensitive compass directly under a wire carrying electric current, and the needle will deflect perceptibly from the north and south position which it normally occupies. The deflection will decrease as the compass is moved further away. It will be noticed that the deflection is always in the same direction, showing that the lines of force always encircle the wire in the same sense with regard to the direction in which the current is flowing.

The following is a simple rule to remember the direction of the encircling lines of force: If the current is traveling in the same direction as a right-hand nut would travel along a bolt when

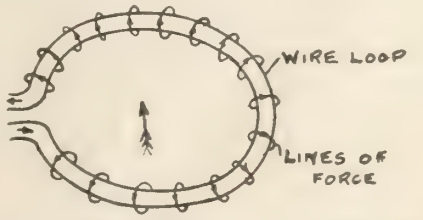


Fig. 5.—Representing how the magnetic lines of force encircling a wire loop, tend to form an electric magnet.

being screwed on, the lines of force will encircle the wire in the same rotative direction as the nut would move on the bolt. Always think of a right-hand bolt and nut.

Now, it can be seen that if a number of coils of wire be wound around a core, the generated lines of force of each particle of length of the coil, would unite in flowing in the same direction, as is shown by Fig. 5. The concerted action of the lines of force can be augmented by concentrating them by the use of a central core of soft iron, which has high magnetic conductivity. Air has a poor magnetic conductivity and so dissipates the lines, spreading them out.

F, G, and H wound upon it, these coils having their ends connected together, the connections in turn being joined to the commutator plates ab, bc, cd, de, ef, fg, gh, and ha. Thus A and B juncture connects to commutator plate ab; B and C to bc, etc.

Now, if current passes into the commutator dc from the lower brush as shown, this current will divide, half going through the series coils on either side of the commutator, through the coils E, F, G, and H, and the coils D, C, B, and A, respectively, coming out through commutator ha to the upper brush. The current in its circuit of these coils, magnetizes the core, causing

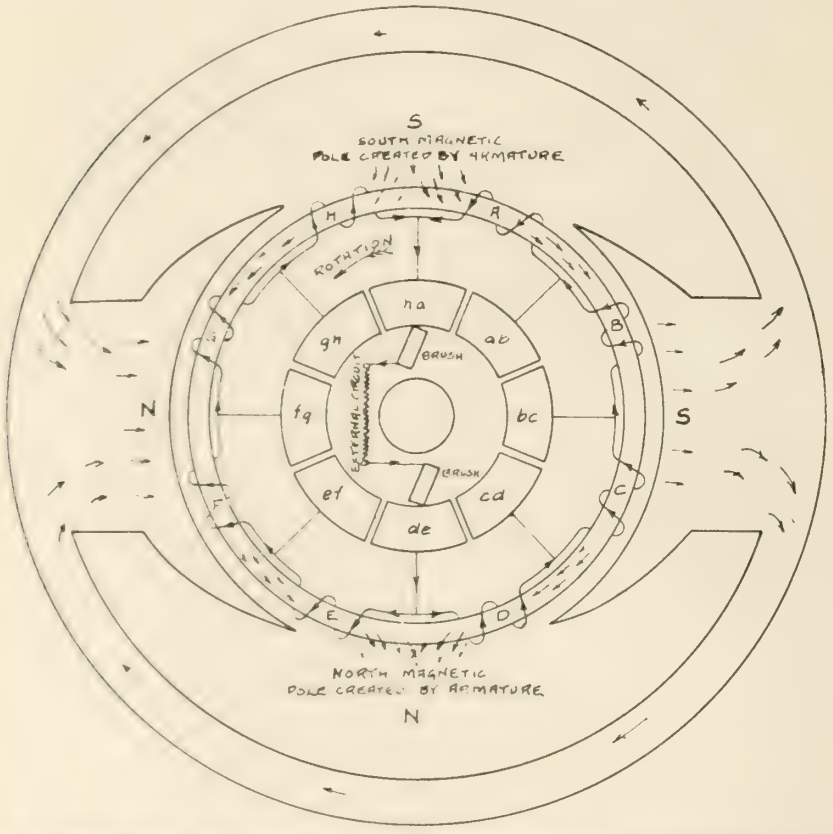


Fig. 6. Diagrammatic Representation of the Magnetic Action in a Bi-polar Direct Current Motor.

This explains how an electro-magnet such as a motor field-coil, is formed, and how it acts.

Simple Motors.

Fig. 6 shows a simple motor diagrammatically arranged for explanatory purposes. For simplicity's sake, it is taken bi-polar, though the explanation applies equally well to the multi-polar motors. Also, for the sake of simplicity assume the field coils to be separately excited, that is, to receive their current from some source aside from the general supply to the armature. Considering the poles as permanent magnets might facilitate the understanding.

The armature, or revolving element, has the the eight coils A, B, C, D, E,

a magnetic flux in both sides, both these fluxes tending toward the bottom as indicated by the arrows. From the rule that the lines of force, or flux, travel from south to north in the magnet, the lower part of the armature will thus be made a north pole, and the upper part a south pole. Like poles repelling, and unlike attracting each other, means that the north pole on the lower side of the armature will be repelled by the north pole of the field coil, and attracted by the south pole of the field coil. A similar action occurs to the south pole of the armature. When the armature revolves through part of a turn, the brushes which are fixed, come on to the next commutator plates, shifting the temporary poles of the armature, thus keeping them always in a position to be attracted and repelled by the respective poles. It is thus that a motor armature revolves.

In actual practice it is not customary to separately excite the field coils, the armature and field coils being connected in parallel or series, with a suitable starting coil in series with the latter to regulate the field current, making the strength of the magnetic field of the field coils of the desired amount.

This discussion has had to deal exclusively with direct-current motors, though the same principles apply to alternating-current motors. In the alternating current motor, the fields are always changing to meet the requirements of the armature fields. In the synchronous motor, the field is supplied with direct current, the magnetism remaining the same. the reversals of the current itself in the armature changing the relative positions of the changing fields in the armature without assistance from the commutators used for direct-current machines. In the induction motor, the constantly shifting magnetic fields of the stationary element, due to the phase changes, draws on the fields created in the revolving element, these latter fields being generated from the induced current from the stationary element. Thus it can be seen that all types of motors are the same in principle, operating on the attraction and repulsion rule of unlike and like magnetic poles.

The writer feels confident that if the foregoing article is carefully perused, that many of the difficulties commonly met with in attempting to gain an understanding of this peculiar force, electricity, will be much simplified. If such is the case, the article has had its desired effect.

Long Wireless Transmission.

The operator at the wireless telegraph station of the Mare Island navy yard recently picked up messages exchanged between Key West, Fla., and Norfolk, Va. The distance from Mare Island station to Key West is nearly 4,000 miles. Transmission wirelessly over a distance as great as this is considered quite an achievement, even over water. In the present case, however, the message was transmitted over land, and had to cross the Rocky Mountains before reaching the antenna at Mare Island. It may therefore be considered a phenomenally long wireless transmission made possible by unusually favorable conditions of the atmosphere. Transcontinental wireless telegraphy is still a thing of the distant future.

Power Plant Troubles, Happenings and Improvements

By Blackrock

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

A LOADED SAFETY VALVE.

WE are indebted to "Power" for the title and illustration accompanying this brief article. What strikes us most is the lamentable fact that such conditions apparently exist to-day in spite of the efforts to educate men away from engineering barbarism. While keeping the engine and boiler room floors clean and free of miscellaneous tools and fittings is commendable, a nail driven in the wall would serve the purpose as well as the safety valve lever and be probably more convenient.

Superstition did not evidently hold sway in the brain of the genius responsible, else an old horse-shoe must surely have figured prominently to ensure good luck.

We are having a population census taken this year, why not have one of steam boilers also taken to see where we are at, and enable us to forecast the explosion probabilities? Learned engineering societies are too much taken up with the field of new development, lesser luminaries in the same profession are too busy fulfilling the eleventh commandment, and governments, well the least said of them the better.

Who then may we look to for action in the matter? What of enterprising journalism? Standard Oil, U.S. Steel Corporation, Cobalt and Porcupine profits would sink into insignificance before those to be reaped from a register of steam boiler equipment and operation.

Fame and honor would have no record to compare with that be attained by a faithful and illustrated portrayal of conditions, and scenes of operation, personality of operators and owners. Rare stamps, coins and antiques would cease to be the most valuable features of the British Museum in presence of this standard work on the 1911 record of the world's steam boilers in operation.

Amusing, instructive and educative, such a compilation would do more in the next couple of years to civilize the barbarians who are gnawing at the vitals of engineering progress, than will the next 100 years of education, invention, preaching, by editorials or legislation.

The leopard may not change his spots nor the hyena his skin, the boiler barbarian may not yield to persuasion, education or the demands of intelligent reason. The leopard and hyena may be and are being driven out. In like manner the boiler barbarian may be and can be driven out.

Again it is asked who will do it? Intrepid, enterprising and faithful journalism is the hope of and has the backing of the engineering profession to do it,

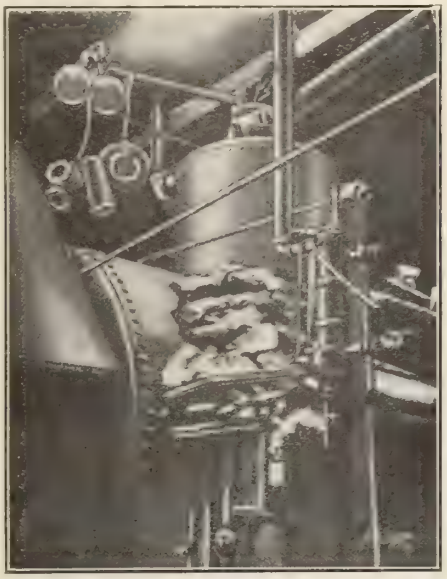


Fig. 1.—The Junk Type of Lever and Weight Safety Valve.

and in the very near future it is sure of creditable fulfillment.

THE PASSING OF THE SMALL STEAM ENGINE.

Of interest to the engineering world, is the gradual yet sure decrease of the demand for small steam engines. The advent of the gas engine and electric motor is producing this effect.

The Gas Engine.

The gas engine as first comer was welcomed by the small power user because unlike the steam engine it needed neither boiler nor attendant and saved space. While, perhaps lacking desirable perfection when introduced, the gas engine may now be said to be as perfect a machine as the steam engine in its smaller size units, for it can be started on short notice, stopped instantly, and with its stoppage, attendance and operating cost cease.

That the gas engine will hold its own and encroach still further into the domain of the reciprocating steam engine, the least observant of us cannot but help realize. Town or city gas is sufficiently cheap to warrant a preferential adoption where small power requirements are involved, while the production of suction gas is now so perfected as to satisfy the demands for larger units at an overhead cost at least equal to that of other known motive powers.

The difficulties encountered with suction gas producers in continuous operation through long periods were only such as might have been expected, and what every new and revolutionizing invention experiences in its initial stages.

It is a matter of oft proven experience that these difficulties have now been largely overcome, as many plants are successfully negotiating continuous heavy loads of one brake horse power hour output per .8 pound anthracite coal, and intermittent and fluctuating loads of one brake horse power hour output per pound of the same fuel.

Previous to the introduction of the gas producer, the field of usefulness of the gas engine was restricted to the radius of a town or city gas supply. That the appearance of the gas producer has removed this restriction and broadened the field of useful application is largely apparent.

The Electric Motor.

The electric motor like the gas engine bears a large part in the passing of the small steam engine. Apart from its application as the sole power in minor industries, it occupies a distinctive place as a distributor of power, and as such compares favorably with compressed air, steam, hydraulic, belt, rope, chain and gear transmission appliances. Direct motor driving of individual machine tools, pumping and auxiliary machinery generally, lead us to believe that in the very near future only the main generating power units will have a steam engine requirement.

Electricity is applicable to most domestic, manufacturing, transportation, mining, constructional and new development operations, and being so may be expected to maintain its position comfortably.

The Steam Turbine.

The appearance of the steam turbine as a power producer, does not affect by delay or help by acceleration the passing of the small steam engine. It is in no sense a competitor in the field of small

power covered by the latter. For large powers it is, however, a powerful rival to gas and oil engines.

Conclusions.

Oil engines operating with crude or refined oil, gas engines operating with [illegible] their own producer, motors operated by electricity generated by a public utility company or by each individual plant, the steam turbine operated by steam which is otherwise a necessity, are all making good at the expense of the steam engine, as we have been accustomed to term the old favorite.

Progress from invention has no sentimentality about it, and blinking at the facts will neither stay them nor be beneficial to those interested.

Manufacturers of commodities affected by the constant changes which are taking place must if they want to keep in the running, adjust themselves to the altering conditions.

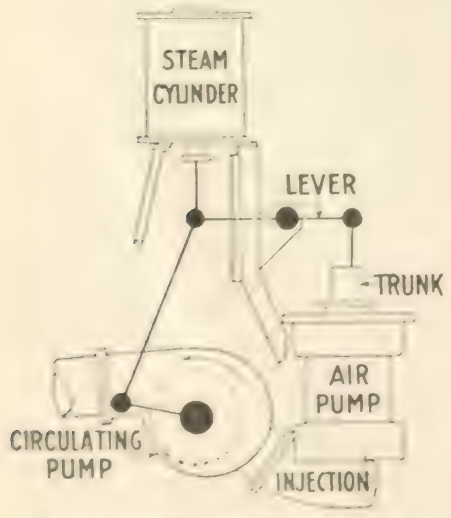
It may be noted that the steam engine is not likely to suffer extinction. Nothing really does absolutely.

The end of a presidential term ensures for its late occupant a place of honor consistent with his past record and adaptation to further service.

The displacement or replacement of the steam engine with its magnificent record, ensures for it likewise some lesser or greater yet further degree of usefulness.

The sailing ship, pleasure and racing yacht fill a cranny in the business, pleasure and sporting life of the world to-day, although steamships and steam yachts usurped their prominence many years ago.

We are not looking for their complete annihilation. The pointed remark of an American writer at the close of a lecture, published in "Engineering" 20 or more years ago is still true to-day, for the America Cup exists and has yet to be won before the racing yacht at least disappears.



[illegible] Pumps.

The candle still fills a place, in spite of electric and incandescent gas light.

Cart and carriage horses are still public and business utilities, despite automobiles and electric street cars.

A feature of the progress and development that is resulting in the displacement of the steam engine is the employment record. Twenty years ago, the manufacture of oil, gas and suction gas engines employed about a score of men. To-day they are numbered by thousands. Thirty years ago, nobody was employed in the manufacture of electrical machinery. To-day they also can be reckoned by thousands.

However we may regard the outlook personally, the larger progress and material prospect for the greater number makes the departure of the steam engine to a lower plane a not unwelcome blessing.

VACUUM AND THE STEAM TURBINE.

The consensus of opinion of those qualified to give expression to it, is that the steam turbine does not yet compete with the reciprocating steam engine at a vacuum of 26 inches or less. Increase of vacuum beyond 26 inches, does, however put the turbine ahead of the engine in the matter of steam economy.

Reasons contributing to this are that the turbine receives the benefit of complete expansion down to the back pressure, and the lower temperature involved does not affect the hotter parts of it, except by conduction. The steam engine may not expand so far, and its cylinder is exposed alternately to extreme variations of temperature.

Designers of steam engines have long ago realized the impossibility of operating the compound engine on vacuums higher than 26 inches, although theoretically, more power would be obtained by so doing, In practice, however, no gain in economy is available with a 28 or 30 inch vacuum, as the increased steam volumes corresponding to the necessarily low pressures make the size of the engine cylinders prohibitive.

Expanding steam adiabatically through a range of pressure from 150 pounds gauge to 28 inches vacuum, shows almost half of the heat energy still available below atmospheric pressure, for conversion into useful work. From this it becomes apparent that an engine exhausting into the atmosphere utilizes about a half only of the available energy of the steam.

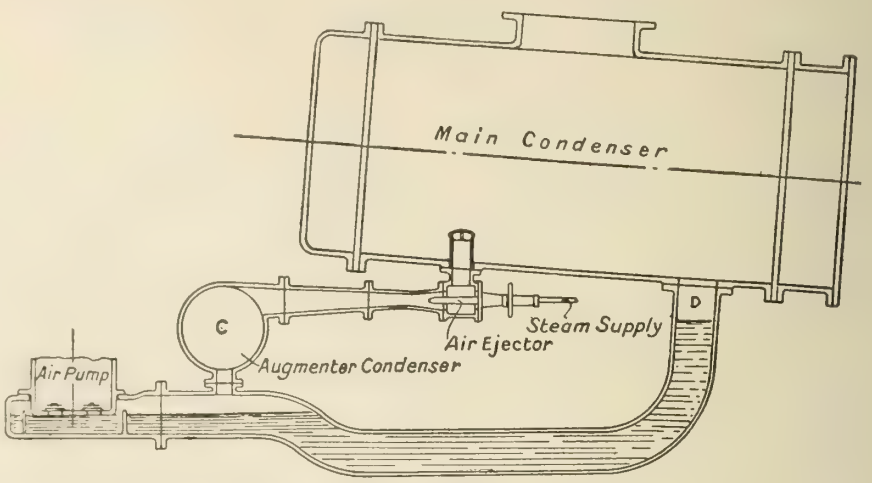


Fig. 2. Parsons Augmentor Condenser Arrangement.

Reciprocating engines show higher efficiencies operating through the higher ranges of steam pressures. Steam turbines show higher efficiencies when operating at low pressures, as from atmospheric pressure to 28 inches vacuum.

Work Done by Difference of Vacuum in L. P. Turbines.

As showing the high heat value of very low pressure steam when applied to steam turbine practice, the following example collected from a marine experience may prove of interest.

With all turbines working at reduced speed and pressures, the h.p. showing

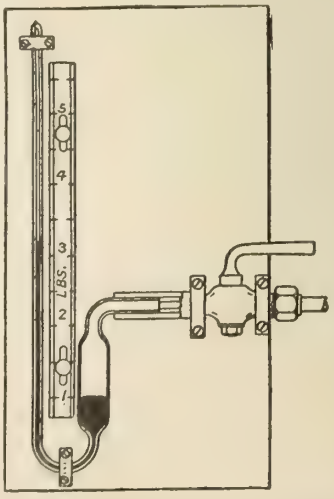


Fig. 3. Absolute Pressure Barometer.

80 pounds initial pressure by gauge; the L.P. showing 7½ pounds absolute initial pressure; there was developed in each of these latter, operating between 15 inches initial vacuum and 28 inches exhaust vacuum, the same power as that developed in the h.p. turbine.

The actual back pressure against the H.P. turbines was reckoned as being 1 pound more than the L.P. initial pressure, and that against the L.P. turbines as being 1 pound in excess of the condenser pressure.

High Vacuum Maintenance.

The maintenance of a vacuum in excess of that suitable to reciprocating steam engine practice, becomes therefore a matter of supreme moment as regards economical operation of steam turbines.

Whether the highest attainable vacuum will prove in the end to be the most economical, depends largely on a variety of circumstances. The equipment necessary for its accomplishment is likely to have a high first cost. Further, the liability to trouble and therefore decreased efficiency, make the maintenance feature of more than ordinary importance.

Factors entering into the question are, temperature of cooling water, type of boiler, fuel and feed water, steam heating, load, location and extent of plant.

Condenser, piping and turbine gland leakage must be zealously guarded against. Leakage at the glands is overcome by the admission of steam which becomes condensed and excludes air leakage sufficient to prevent undue harm.

Dry Air Pump.

Air, most of which is carried over with the steam, is best dealt with by a separate pump, known as a dry air pump.

The sketch, Fig. 1, illustrates a combined ordinary air and circulating pump. A dry air pump has been designed and manufactured by G. and J. Weir, Cathcart, Glasgow, expressly for high vacuum attainment in turbine condensers. This unit is of course additional to the ordinary air pump for dealing with the condensed water.

The Weir dry air pump drains only the air or vapor from the condenser. It is usually located high up, and results got from its use, record a 29 inch vacuum. The air pump chamber is kept cool by means of a water jacket.

The Hon. C. A. Parsons speaking on the subject of vacuum, says that "an addition of 1 inch to the vacuum over 26 inches, deducted 4 per cent. in the condenser alone from the amount of steam used, an increase of one other inch meant a further gain of 4½ per cent., and a 29 inch vacuum showed 5½ per cent. more again."

Parsons Vacuum Augmentor.

The purpose of the vacuum augmentor is to realize, say a 28 inch vacuum without materially adding to the cooling surface or fitting larger air pumps than required, on the ordinary 26 inch vacuum arrangement.

Fig. 2 shows the application of the apparatus.

The small steam ejector drains the air and vapor from the main condenser and discharges it into the auxilary condenser C.

The latter in practice has a cooling surface of about 1-20 of that of the former.

The air pump suction pipe is arranged so that a water seal exists to prevent air return to the main condenser.

Due to the inequality of levels of the air pump and condenser there is a difference in vacuum of 1½ to 2 inches, a circumstance of much advantage to the former.

Air is a bad heat conductor and hinders the condensation of the steam, therefore the more rapid its extraction from the condenser, the more efficient will be the cooling effect

At a given temperature there is a minimum quantity of water that will condense a given quantity of steam, and for land installations this becomes a feature of supreme importance.

Absolute Pressure Barometer.

Fig. 3 illustrates an absolute pressure barometer, the use of which in some form or other, is recommended by steam turbine experts to compare vacuums recorded.

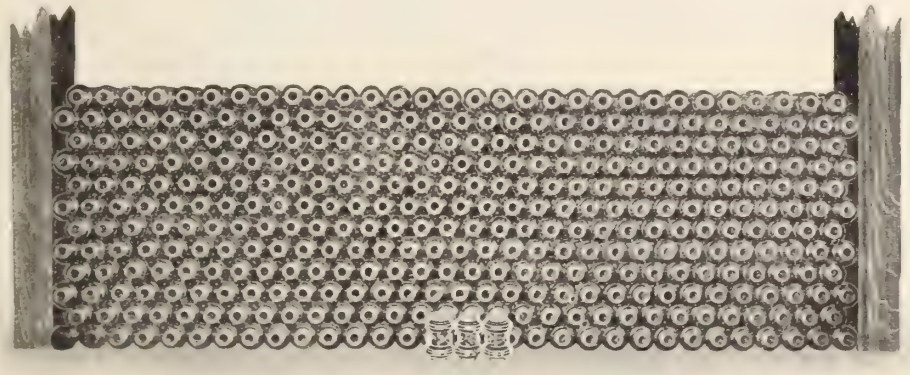
The 30-inch barometer or assumed atmospheric pressure of 30 inches is variable according to circumstances and location.

With so close approach to a perfect vacuum in steam turbine operation, it has become necessary to adopt an apparatus, beyond question reliable. With this absolute pressure barometer, some care must be taken not to disturb violently the column of mercury by opening and closing the cocks suddenly, else the column is apt to break and cause an air bubble or water vapor to enter the vacuum side. From what has been said it will be noted that high vacuum is an accessory requirement to steam turbine economy.

The writer is indebted for copies of cuts and extracts of text, to the publications "The Marine Steam Turbine" and "The Theory of the Steam Turbine," by J. W. Sothern and A. Jude respectively.

BALL BEARING AND HANGER INSTALLATION.

One of the largest installations of transmission material manufactured in Canada during the past year was recently shipped by the Chapman Double Ball Bearing Company of Canada to the N. T. Ry. shop at Transcona, Manitoba. It included 369 Chapman double ball bearings and hangers for 2 15-16 inches diameter shafts. The bearings alone, as illustrated, covered a space of 22 feet by 8 feet.



Group Shipment, Chapman Double Ball Bearings, N.T.R. Shops, Transcona, Man.

A large and increasing demand for ball bearings for transmission purposes in railroad shops and factories is a growing sign of the desire to improve the overall efficiency of belt and rope drives by reduction or elimination of bearing friction.

As showing that reliable, practical and high efficiency results are being obtained, and that those responsible for the determination of transmission equipments in our large Canadian corporations are awake to this information, we may instance ball bearing equipments in the railroad shops of the I.C.R. at Moncton and Riviere du Loup, the G. T. R. shops at Stratford, and the C.P.R. shops at West Toronto.

When a gage glass breaks, to avoid being scalded shut off the water first, then the steam.

BABBIT METALS.

By A. A. Greenbargh.*

THERE is perhaps, at the present time, no term in the mechanical world so ambiguous and so misused as the term "Genuine Babbitt." It is popularly believed that "Genuine Babbitt" is the composition originally compounded and invented by Isaac Babbitt, to whom we are indebted for the invention of making soft metal linings for bearings. In U.S. Patent No. 1252, July 17, 1839, granted to him, a suitable composition is mentioned, consisting of 50 parts tin, 5 parts antimony and 1 part copper. Now what his patent specifically covers and what he claims in the same, is simply the method of application of a soft lining in bearings. The formula given was for the purpose of making his specifications complete for patent office requirements. The value of his invention in his own mind related to the construction of bearings rather than to the production of an anti-frictional metal.

Later, Mr. Babbitt gave the question of the composition of his alloy some thought, and he realized that the hardest alloy consistent with other requirements was the best for him to use. The formula for his favorite composition, which some years later he sold to a Mr. Phillips, an American manufacturer, was quite different from that first mentioned in his patent, in that it contained 10 parts tin, 1 part antimony and 1 part copper. At the outset, Mr, Babbitt himself had no exact composition which he used for his linings, wherefore the term "Genuine Babbitt" cannot be used in the sense that it is Babbitt's original composition; and further it is impracticable and cannot be used as a definite specification.

Babbitt Compositions.

Still greater uncertainty is brought out by chemical analysis of the different metals sold under the trade name of "Genuine Babbitt." If the term ever meant anything at all, it was simply this: that the preponderant constituent was tin, and that its two other constituents were antimony and copper.

Until recent years the term generally implied that the composition was free from lead. This however is no longer the case, because the low cost of antimonial-lead as a by-product for the last fifteen years, and the constant increase in the price of tin have weighed so heavily on the manufacturer of "Genuine Babbitt," that to-day the term no longer positively excludes lead from its composition.

Engineers and machine builders realize that there is no such thing as one universal bearing composition that can be considered as the best and most serviceable alloy for all requirements. Bearing metal should be specified with the same degree of care and decision as any other metal used in the construction of modern machines.

Manufacturers offer alloys of widely different compositions and it is impossible to rely upon fanciful labels and brands. While apparently there should be only one "genuine," there is no reason to believe that Isaac Babbitt's formula of fifty years ago, if taken as a definitely exact composition, should apply to the completely altered bearing conditions of to-day.

There is certainly a great question as to the adaptability of any one formula to the wide range of conditions which must be provided for in these days, so that there is justification for the intelligent manufacturer in departing from any established formula; such action is due to an increased knowledge of the metals and metallurgical processes and the necessity for economical construction.

As a matter of fact, nearly all bearing metal requirements could be met with Babbitt's composition of 10 parts tin, 1 part antimony and 1 part copper. The real merit of a bearing metal lies in its giving satisfactory service at a minimum first cost

The heating of bearings is the principal cause of annoyance, and in cases where the metal punishment is so severe that heating cannot be avoided, a metal of high melting point should be selected. The efficiency of the alloy, therefore, depends upon the quality of the wearing surface that can be produced and maintained under service. A properly selected metal carefully applied, both as to design and workmanship, produces a bearing which, with proper lubrication, has no metallic contact while running. That is, the journal and its bearing are separated from each other by a film of oil which is maintained in operation. As soon as the movement of the journal is stopped, the film of oil is gradually squeezed out and the metallic surfaces are brought into contact. Therefore in selecting the metals for a bearing they should be sufficiently dissimilar so that when starting the machine, there will be no danger of scoring the shaft until the oil film shall have been restored.

Manufacturing Methods.

Manufacturing methods have a very important bearing on the serviceability of different alloys. The chemical analysis of a Babbitt, giving the constituents and their relative proportions is of course of some value in determining the quality of Babbitt under consideration; but more important still are certain fundamental, chemical and metallurgical laws according to which the constituents should be united, and if these laws have not been observed, a very inferior product will be the result. It is not the purpose here to give a metallurgical treatise but to suggest ideas that should be observed in the handling and applying of lining metals.

In general, these metals should be melted in an iron vessel and kept covered as much as possible in order to prevent excessive oxidation. They should be heated considerably above their melting point before using, but must not be kept in a molten state at a high temperature longer than necessary. Overheating should be carefully avoided, and a good rule for general practice, is to heat the molten babbitt to a point where it chars a pine stick, at which temperature it casts perfectly.

Selection of Babbitt Mixture.

The analysis of service conditions is the first important step in the selection of the most economical Babbitt for any requirement. The variable conditions of applying a bearing, as well as the care, method and nature of lubrication, all have a distinct effect upon the final results.

Where the service conditions are severe, owing to great pressure, a metal having considerable compressive strength is necessary regardless of what the speed may be, and this condition would require a relatively high percentage of tin. Where there is high speed and the pressure light and moderate, a metal having a fairly high percentage of lead may be used. In the same manner with intermediate conditions between pressure and speed, correspondingly intermediate compositions can be selected.

The surroundings of a bearing should also be taken into consideration if they are at all unusual.

Care and Attention of Bearings.

The question of care and attention that a bearing receives should also be taken into consideration. A bearing that is lubricated at long intervals or with a poor grade of lubricant requires a higher grade of metal than that which would be required under more favorable conditions.

There is nothing very difficult in making Babbitt suitable to any kind of service. It is only necessary that the work be done by an experienced metallurgist. Right here is where we see the importance and value of dealing with a maker whose experience and reputation are above question and who produces alloys of high quality and sells them honestly at fair prices.

---

* "Babbitt" specialties the Lumen Bearing Co., Toronto and Buffalo.

Mechanical Drawing and Sketching for Engineers*

By B. P.

A Series of Progressive Lessons Designed to Familiarize Engineers With the Use of the Apparatus Necessary to Make Simple Drawings, to Encourage Them to Realize How Important a Factor it is of Their Equipment, as Well as Being a Profitable Pastime.

AN accessory to progress and good drawing work is a reliable equipment of tools. This need not be too expensive unless the aim is ultimate daily use in a drawing office. The various items described are such as will be found at least sufficient for the course as already out lined.

Apparatus and Applications.

The first necessary requirement is a drawing board, and this should be as large as can be conveniently handled in an ordinary furnished room. Sizes 17 by 24 inches minimum to 23 by 32 inches maximum will in most cases be found suitable. Fig. 1 in our first article of the series showed an adjustable board and table combined, while Fig. 2 shows a simple board for use on a table or bench.

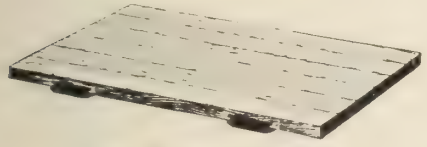


Fig. 2—Drawing Board.

The drawing board should be located where you have the benefit of a good light and your relation to it such that the light strikes the work from the left hand top corner. To realize the full effect on your paper, the light should be shaded, and to obviate excessive stooping, the board should be placed conveniently high and slightly sloped toward you, care being taken that the slope is not so great as to cause your tools to roll or slide off.

The drawing paper should be bought in sheets of sizes 15 by 20 inches and 22 by 30 inches respectively to suit the drawing boards already referred to and ensure no overlap beyond the board edges. Paper used of the full size of drawing board may run just over the edge on which the head of the tee square slides and does not therefore give a truly square line to that edge. When overhanging the other edges it invariably gets ragged and inclines to tear in on the work.

Drawing sheets are not usually perfectly square edge to edge, therefore when fixing to your drawing board see that the edge next the tee square head or left hand is parallel with that edge of the board.

Fig. 5—Bale Head Drawing Tacks.

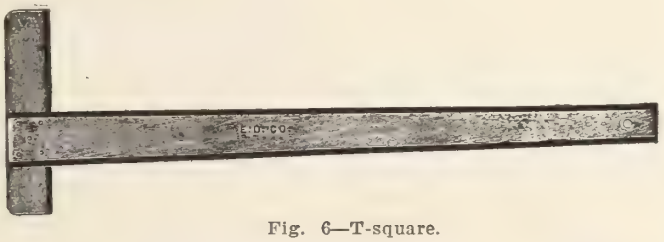


Fig. 6—T-square.

For practice purposes good paper is indispensable and Whatman's hot pressed demy and imperial are recommended.

Regular drawing office work admits of very inferior quality of paper being used, the reasons being that the draftsman is usually expert enough to treat it tenderly while making use of it and that immediately the tracing copy is made, the drawing sheet finds a resting place in the waste paper basket. You, if a beginner, would experience much disgust with your efforts and their effect on poor quality paper. As it is an intention to minimize your self-abasement as far as possible, good quality paper in your hands becomes a necessity.

Figs. 3-4-5 illustrate various styles and sizes of drawing tacks, those with the bevelled edges, Fig. 3, being perhaps the most suitable at a diameter of ½-inch. One tack should be placed at each corner about ½-inch in from the edges of the paper and a further tack placed at the lower edge about the middle of the paper length, also ½-inch in from the edge of the paper. Tacks should never be placed on the left or right hand edges intermediate to those at the corners as they interfere with the movement of the tee square and tend to chew its edge. The drawing paper should be drawn flat and tight when being tacked to the board.

The tee square, Fig. 6, should be at least the length of the drawing board between the inside of head and point and should not exceed that distance, if possible for convenience. A tapered blade as shown gives usually a better balanced tool, and excess length upper part head over the lower should be a feature. This admits of the tee square being operated close down to the lower edge of the sheet without danger of the horizontal lines being out of square with the left hand edge of the board through insufficient bearing surface of head. The drawing edge must never be used for cutting paper.

The tee square should be hung up by the hole in blade when not in use and in the case of it falling to the floor accidentally at any time, a line previously drawn by it on the board and used as a setting standard should be taken to reset the blade if it has shifted.

The purpose of the tee square is the drawing of right angled horizontal lines, and the forming of a base on which the triangles or set squares rest when vertical or angular lines are required.

Fig. 3—Bevel Head Drawing Tacks.

Fig. 4—Stamped Drawing Tacks.

* Second of a series of an Instruction Course. A lesson will be given each month.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV APRIL, 1911 No. 4

POWER AND ITS TRANSMISSION.

There has been a development in the transmission of power that would not have been prophesied by the most optimistic a very few years ago. Great economies have been made possible in belt, chain and rope drives because they have been studied and each used where the conditions were best suited for that particular drive. More has been learned about pulleys, shafting, lubricating oils and bearings. There has been advances made in the use of the gas engine and unprecedented advances in electric transmission.

The development of water powers and the adoption of motor drive in machine shops are probably two of the most potent factors in the development of electric drive and electric power transmission. A few years ago a pressure of 20,000 volts was thought to be a maximum. Now the Hydro-Electric Commission of Ontario have a line operating at 100,000 volts, and it has been tested up to 135,000 volts. Where formerly power was transmitted 50 miles it is now distributed over lines extending 200 miles and more from the generating stations.

The future development cannot be prophesied. Research work may show a cheap method of utilizing electricity for heating purposes, and would be a great boon to the central Canadian provinces, which are dependent on a foreign country for coal. To those interested in economical power transmission it is hoped that the April issue of The Power House will prove of great value.

WHAT DO YOU KNOW?

"What do you know" is a salutation phrase invariably used by a well-known Canadian engineer when addressing those associated with him in carrying out some engineering project.

It expresses not only a desire to know how the work is progressing, but a receptiveness for suggestions and information from the brain of another, by which he may apply himself and enhance an already well developed intelligence.

The same salutation would in many cases be an opening for the introduction of the latest gossip on the part of men as well as women, and would naturally have the reverse effect as regards acquirement and development of intelligence.

"What do you know" seems to us to imply the exercise of eye, ear and hand, each directed and governed by an active and reasoning brain system. Sub-dividing, we might call the exercise of ear and eye a well developed habit of observation, and that of the hand the instrument for putting it into effect.

Illustrative of the point and something familiar to all of us, as a not altogether remote possibility is a crowded street car going along at a good clip with the motorman just fallen in a faint. "What do you know" about controlling a street car, might be a very painful experience for you if a woman elbowed your fear-shaken frame to the one side and took charge.

A myriad other awkward situations might be cited as necessitous of silent observation and mental record, the majority of which may become apparent to the reader on a little reflection.

Emergencies arise every day for the exercise of somebody's observation, "what somebody knows," and the trained man or expert may not happen to be there. As a matter of fact the irony of fate seems to rule it otherwise and the novice or amateur is called upon to avert or minimize disaster and preserve life.

It is incumbent we think on the part of everyone, to cultivate a keen observation and perception of the conditions by and under which we live, not only with respect to our own particular and chosen calling, which, of course, must always have precedence, but in the various accessory features as well, that go to make a day's life and work.

The man who observes most, knows most, in his own particular line is the more likely to keep his eyes and ears open and alert for pointers in other fields, and while this latter is here perhaps given extra prominence, its inception and operation like charity must begin at home.

Interfering with the rights, privileges or professions of others is in no sense meant to be conveyed, because that particular species of "what do you know" needs no cultivation, being naturally inate, of luxurious growth and hurtful.

What has been commended, is and will be helpful to ourselves and others when an emergency arises, and while we may not be as graceful and apt as the trained man, the result can be the same, thanks to "what we know" from cultivation of the faculty of industrious observation.

ESTABLISHING THE HORSE POWER MEASUREMENT..

A contemporary journal prints an interesting paragraph regarding the establishing of the horse power measurement. Enterprise then as now was responsible for 33,000 foot pounds per minute being made the basis of reckoning.

Watt, after careful investigation, concluded that the actual power of a horse was equivalent to 22,000 foot pounds per minute. Business being somewhat dull in steam engines, because people then as now, were more or less sceptical of new inventions, he determined on inducing power users to purchase, by fixing a rating 50 per cent. in excess of what his investigations had proved a horse capable of.

The plan seems to have had the desired effect, and whether out of compliment to the originator or a natural abhorrence of change, no more popular unit of measurement is to be found in our power and mechanical vocabulary.

The question of breed of horses with which Watt made his experiments, or the extent to which the unit is false, need not enter into our minds to-day as being of consequence. Comparison of mechanical power with horses has long ceased to be a factor, and the unit amount is primarily and wholly valuable in that it is a universally accepted basis of mechanical power comparisons.

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IS IT WORTH WHILE?

Most of us ask ourselves this question now and again, and answer it in the affirmative, but somewhat half-heartedly. In whatever station placed, men at times feel that conditions do not wholly satisfy. Want of recognition of our efforts by superiors, insufficiency of salary and blighted ideals; each and all conspire to more or less despair.

There is a proneness in human nature to self-glorification, and therefore if opportunity for its exercise be not often present, despondency supervenes. With operating engineers, the wage question is responsible to a large extent for much unrest and much uncertainty as to its being worth while to increase qualification, by intelligent educational application to the many important details of their chosen profession.

It is instanced that practically no improvement in wages paid is to be noted in the last twenty years, and that the same sage advice to qualify is being handed out by technical journals to-day as was then. While the latter at least is admittedly true, it can yet be deemed to be a present day necessity.

There are disabilities in every field of human endeavor; the personal and highly selfish ambition is strong and insatiable in all of them, and only by a certain self-forgetfulness, in the desire for the general uplift, will each of us do his alloted share, and in the performance of which reap personal benefit.

Operating engineers have everything to gain by grasping every opportunity of improving their personal qualifications, and although the advice may savor "chestnutty," there is no other means by which their desire for increased remuneration will be realized.

Bargain days and get-rich-quick schemes are everyday commonalities, yet never before was value for value so keenly insisted on as it is now. The square deal is becoming more and more the crucial test between a man and his fellow, and unless you as an operating engineer can impress your employer that he is reaping the equivalent outlay return, we are afraid that it will be necessary for you again to ask, "is it worth while ?"

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GRADED CERTIFICATES FOR ONTARIO.

The advisability of having graded certificates is becoming more evident. The caretakers of the heating plants in large buildings must hold certificates and these men with an Ontario certificate are as much qualified (according to the Ontario law) to operate a 500 or a 1,000 h.p. plant as the engineer who has the necessary experience and education. If a holder of an Ontario certificate presents it to a manufacturer in seeking a job, the employer has no means of distinguishing between applicants until something happens in the power plant to reveal a man's inefficiency.

There must be a starting point. There had to be when certificates were first granted all engineers with two years' experience. Now all taking out certificates must write an examination. In this way the graded certificates may be introduced, that is, make the third class (the present certificate) obligatory and make the first and second classes optional. Then if an engineer holds a second or first class certificate, an employer can at once tell the standing of the engineer both regards experience and knowledge.

The stationary engineers are in favor of it as shown by the expression of opinion by them. The following statements refer to graded certificates and have been made to The Power House by letter or at meetings of engineers, etc.

J. J. Heeg, Executive Pres. C.A.S.E.—The law is all right as far as it goes. I am in favor of strengthening the weak places and then securing graded certificates.

W. Norris, Ex. Vice-Pres.—There should be some system by which engineers may be recognized and the employer know the amount of responsibility that can be placed on an employe.

W. A. Crockett, Ex. Secretary.—The present law is a beginning. We must have better as time rolls on.

W. A. Sweet.—A step in the right direction.

R. Manly Orr.—Certificates should be graded so that all engine owners can tell the ability of the man by the paper he holds.

J. O. B. Latour.—Graded certificates which show the knowledge and experience of the engineer will prove satisfactory.

J. E. Noble.—I am in favor of graded certificates along common sense lines but do not favor some of the present laws which act against the practical engineer.

Fred Nagle.—If the Government took as a basis for future improvements the old O.A.S.E. certificates, I think it would be a great deal better than the present system.

W. J. Wilkinson.—That graded certificates are necessary, is admitted.

W. G. Walters.—The act will be improved when the engineers unite, agree upon what they want and make representation to the government.

Hon. Adam Beck.—You will find the government always ready to help you keep abreast of the times and we recognize that your claims that all engineers should be properly qualified is a proper one.

Chas. Kelly.—I believe some amendments would be of value, such as graded certificates.

The graded certificate has also received the commendation on various occasions, of such well known engineers as A. M. Wickens, Kastella, Clark, Terry, and numerous others.

The fact is that all it requires to secure graded certificates is the co-operation of the engineers. W. G. Walters has expressed the idea exactly and Hon. Adam Beck has intimated that the request will be fully considered. The engineers should arrange a committee to interview Hon. Mr. Duff and the Stationary Engineers' Board, and the legislation will no doubt be secured at the 1911-12 session of the legislature.

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TOPICS OF THE MONTH.

Engineers can now lay up the heating apparatus for the summer. There will be a welcome saving in the coal bill for the next few months.

Many Canadian companies are now finding it convenient in addition to making a great saving, to buy coal according to specifications. It is the best way.

When head and hands work together, it is an ideal combination.

Progress and Development of Hydraulic Engineering

By Penstock

No Apology is Necessary for Our Featuring Hydraulic Engineering in Canada. This Country Lends Itself Naturally to a Development and Progress Along the Lines of Every Description of Water Power Equipment, and the Idea in This Particular Section of Our Paper is to Make Known What is Doing and Who is Doing it Throughout the Whole Field.

THE LEBLANC CONDENSER.

The Leblanc condenser represents the development of that class of condensing apparatus known as the jet type. Radical improvement in economy and efficiency usually means additional and complicated parts, but as regards the Leblanc equipment, the desirable end has been attained without the undesirable features.

The steam turbine revolutionized steam engineering practice in half a dozen years and the Leblanc condenser bears the same relation to the familiar type of condensing apparatus that the steam turbine does to the reciprocating engine. It is in fact a turbine type condenser. Like the turbine it occupies only a small fraction of the space formerly allotted, and further like the turbine it develops superior efficiency, not by the multiplication of parts, but through a simple application of rotary motion.

Leblanc Condenser Features.

The requirement of a high vacuum for the economical operation of steam turbines has resulted in the introduction of dry air pumps and vacuum augmentors additional to the already existing accessory apparatus. These of course contribute to increased first cost and upkeep, and not improbably increased uncertainty of operation. The Leblanc apparatus also aims like these at the maintenance of a high vacuum by separate removal of water and air, but through the medium of a pair of small turbine type rotors mounted on a common shaft in a single unit casing.

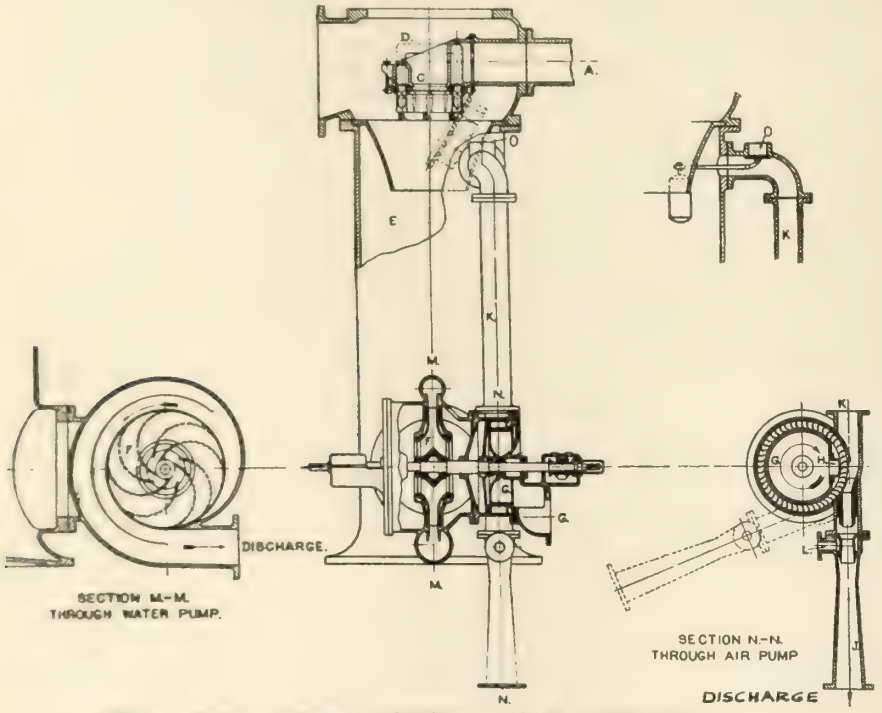


Fig. 1—Sectional Views of Condenser, Air and Water Pumps.

Fig. 1 shows sectional views of the standard Leblanc condenser, from which it will be noted that the chamber in which condensation takes place is only slightly larger than the main exhaust pipe. The injection water enters at A, by virtue of the vacuum within the condenser, and is drawn through the induction passages B-B-B. It then meets and is intimately mixed with the exhaust steam, which has entered either at the top or side inlet on the condenser head. The mixture of condensed steam and water drops through the large combining cone into the chamber E, and is discharged by the centrifugal pump F. If desired, this pump can be proportioned to deliver the hot water to the top of a cooling tower or through spray nozzles, or against any pressure such that the head imposed, including friction, is not more than 50 feet above the condenser base.

It will be noted that the nozzle plate C can be swung into the position shown in dotted lines so that any debris that may have lodged there can be cleaned out. Access to this plate may be had through manholes on the side of the top chamber. The nozzles have liberal passages, and if proper screens or strainers are placed in the water intake it should not be necessary to clean them.

The air pump draws its air through the pipe K, a sectional view being shown to the right in Figure 1. To start it in operation, high pressure steam is turned into the connection L. The cone near L forms the annular nozzle of a steam ejector, so that on opening the valve in the steam line to L, a vacuum is created in the body of the pump. The chamber G, being piped up to a source of water supply, is immediately filled on account of the vacuum created by the steam ejector. Water

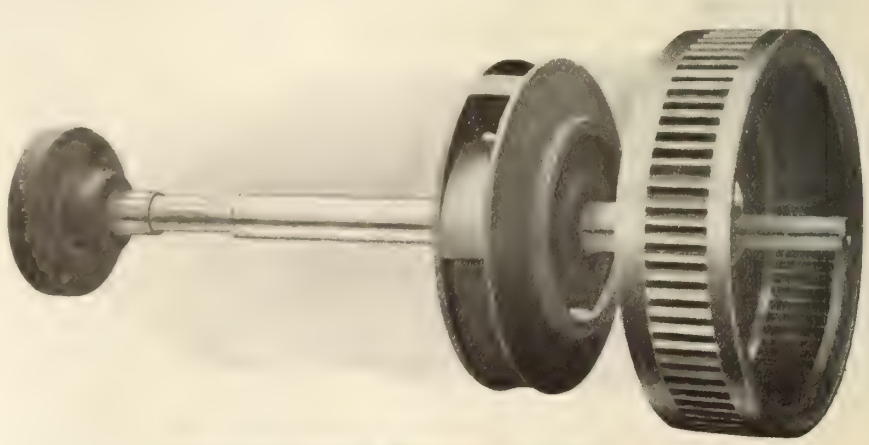


Fig. 2 Sole Moving Element in Condenser.

then flows through the distributing nozzle H, and is projected in layers in a downward direction through the combining passages into the diffuser J.

Between the successive layers of water, layers of air are imprisoned, these layers of water (on account of the high peripheral speed of the turbine wheel which throws them downwards) have a

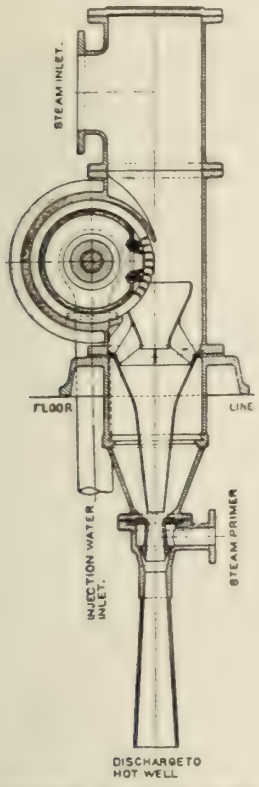


Fig. 3—Condenser for Units Under 300 H.P.

velocity sufficient to enable them to overcome the pressure of the atmosphere, and force their way out of the pump in which a high vacuum exists. The layers of water act like a succession of water pistons with large volumes of air between them.

In the elbow on the top of the pipe K there is a valve controlled by a copper float on the inside of the condenser chamber. This valve will open, should the water for any reason rise as high as the float, and by admitting air, lower the vacuum to such a point that no more water will be drawn into the condenser. This vacuum breaker is placed on the condenser to cover such unforeseen emergencies as the shutting down of the pump by a careless attendant, and will prevent flooding of the condenser from any external cause.

The float is so situated that under ordinary operating conditions, it is not in contact with the water, but is immersed only in emergencies such as already referred to. Above the float is the condenser cone which acts like a hood and protects it from the erosive action of the water. The float therefore is wholly reliable, positive in movement and certain in action.

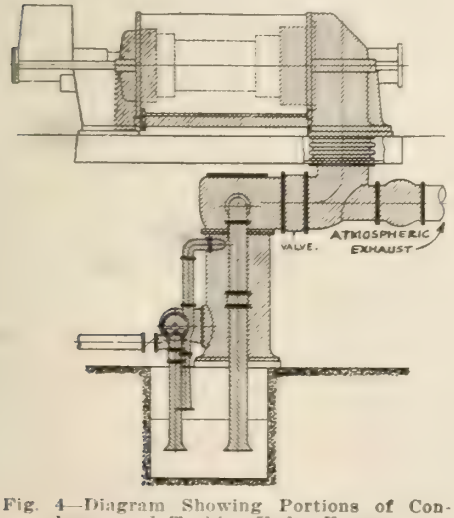


Fig. 4—Diagram Showing Portions of Condenser and Turbine Under Vacuum.

In Fig. 2 are to be seen all the moving parts of the condenser, and in cases of salt or impure water, the runners and shaft are of bronze.

Fig. 3 shows a sectional view of the apparatus as fitted for units under 300 horse power, and Fig. 4 a combined installation of steam turbine and Leblanc condenser with the parts under vacuum shown shaded.

From what has been already said it will be apparent that a minimum of care and attention is required. The glands are water sealed to prevent air leakage, and the shaft bearings are ring oiled. The Westinghouse Machine Co., Pittsburg, Pa., are the licensees and manufacturers of the Leblanc condenser.

DEVELOPMENT OF STEAM PUMPING ENGINES.

The earliest record of the use of steam for power purposes is 130 B.C. At that time Hero of Alexandria, Egypt, made a ball, pivoted at opposite points of a diametrical line, and caused it to revolve by the reaction of steam jets. Hero's apparatus was a toy, and not until the 17th century did practical use of steam for the purpose of raising water become an accomplished fact. The first practical application of the power of steam was therefore brought about by the demand for and possibility of pumping water. The earlier attempts to employ steam for this purpose were along the lines of the modern pulsometer operation, but unlike it were not self-acting.

The question of high operating economy has entered largely into steam pumping development, and it is not going beyond the mark to say that this feature has been and is still maintained. Quick revolution engines while capable of high economy in their particular sphere, do not compare favorably with the slow running steam pumping engine. In operating cost and tear and wear, they are also unfavorably placed in comparison with the latter.

Fig. 1.—Watt's Pumping Engine. Year 1777.

Fig. 1 illustrates the Boulton and Watt steam pumping engine erected in the year 1777 for the Birmingham canal navigation. This honored relic was only removed a few years ago from its original bed and re-erected for exhibition purposes, after an almost incessant service of 120 years. Its builders describ-

ed this old-time masterpiece as a single acting beam engine, having chains at each end of a wood beam, and a steam cylinder 32 inches diameter by 8 feet stroke.

Fig 2 illustrates a Worthington high duty steam pumping engine installed in the low level pumping station, Montreal waterworks. A comparison of the two pictures gives one at a first glance, an idea of the enormous gulf now separating them, and bids almost question the possibility of the first crude effort being the inception of the other. Probably the most direct method of ascertaining the extent of the advancement made, would be to compare the Boulton and Watt terse description of their machine with the elaborate designs and specifications to be found accompanying a present day tender.

If we but pause to realize how replete is this modern machine, with its multitude of specially devised contrivances, each the offspring of inventive genius, and that hid from immediate view, there are numerous mechanisms employed in the development and conservation of that energy which imparts movement to the lifeless mass, a still greater and more extensive conception will again be had. Nor have we in the foregoing, exhausted the wonders of this modern machine; there yet falling to be added all that is implied by high-pressure steam, superheat, insulation and the like.

WATER TURBINES.

The steadily increasing development of Canadian water power resources for public utility purposes, draws attention to what is probably the most outstanding and prominent feature of the many engineering triumphs that the opening up of this Dominion has been responsible for.

It has been said that in no department of what might be termed the wide and inclusive field of mechanical engineering has a fuller realization been attained of the theoretical laws governing its application, than that of this the water wheel and water turbine section. The inflow of capital, the yield of wealth from agriculture and minerals, the populating of the vast unoccupied territories, is turning the attention of financiers and engineers to the necessity of harnessing these tremendous power factors and bringing them within the control and to the service of the nation, the municipality and the individual.

Engineers and manufacturers in Britain, Canada, the United States and the continent of Europe are competing and vieing with each other in catering to this development, and as a consequence, the quality of equipment being offered and installed is of the highest grade. That there is room for each and all of them, the manufacturer of large as well as of small power units, a study of the immense undeveloped water power areas of our country, clearly indicates.

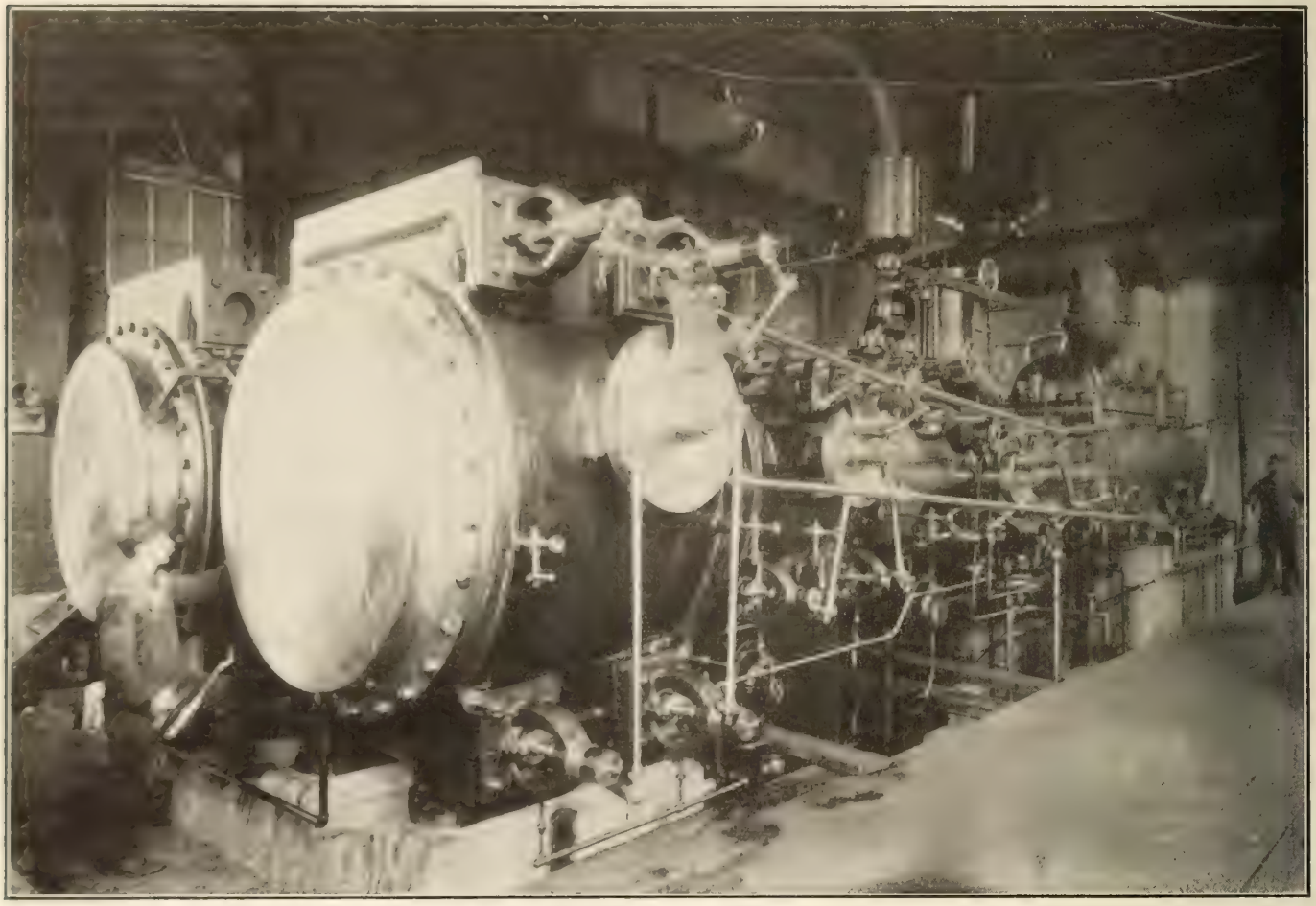


Fig 2—Worthington High-duty Steam Pumping Engine, Montreal Waterworks.

Utilizing water powers hitherto running to waste is an addition to the nation's wealth just as much so, as is the extraction and mining of coal, iron and precious metals.

LARGE WATER WHEEL.

The John McDougall Caledonian Iron Works Co., Montreal, have been awarded the contract for a 10,500 h.p. water wheel for an extension of the hydro-electric plant of the B.C. Electric Railway Co., at Lake Butzen at a cost of about $50,000. This company is now developing 33,000 h.p. and has a 6,000 h.p. steam plant. The new waterwheel which is of the Doble type will operate under a 380 ft. head. The new wheel is a duplicate of a Doble wheel supplied two years ago to the B.C. Electric Ry. Co.

Boiler Design, Construction, Operation, Repairing and Inspection*

By H. S. Jeffery

Repairing Tubular Boilers.

(17) The repairing of a tubular boiler is a simple matter—a very simple matter. The chief consideration is to make the repair so as to weaken the boiler as

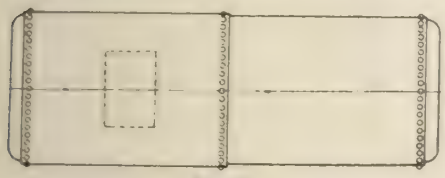


Fig. 21.

little as possible, and to apply the patch in such a manner so it will serve as near as possible the part it replaces.

The applying a patch to any boiler in such a manner as will necessitate the work being done over within a short time, which usually means more extensive repairing in the second instance, is due to two reasons, and they are: Haste and incompetency on the part of those making the repairs. The incompetency in this instance, means lack of knowledge of boiler reconstruction, or in other words the repairing of a boiler in a practical manner.

Take for instance a tubular boiler. Now, if the shell sheet is to be patched, the hole in it should never be cut as shown in Fig. 21; it should be cut in the manner indicated in Fig. 22. The sharp corners of the hole, Fig. 21, will permit under the panting or the breathing of the boiler the shell plate to crack from the corner into the solid plate. Also, since the patch would be applied with a single riveted joint, the cutting of the hole in the shell plate, as shown in Fig. 21, would place in the longitudinal plane a single riveted lap joint, which, of course, would have an efficiency greatly below the efficiency of all other joints in the same plane.

The manner of installing the hole in a shell plate, as shown in Fig. 22, over-

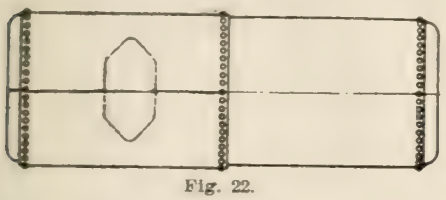


Fig. 22.

comes cracks into the solid plate as previously mentioned. In addition, it will be noted, in Fig. 22, that there is no single riveted lap joint in the longitudinal plane. The hole in the shell plate, Fig. 22, permits a single riveted lap joint in the transverse plane, and the rivets should be so pitched so the efficiency of the joint of the patch is the same as the girth seam of the boiler. It will be noted that a portion of the single riveted lap joint would be diagonal, which is the best arrangement that can be made, and one which is to be preferred to the single riveted lap joint in the longitudinal plane.

Inside and Outside Patches.

(18) A subject which boilermakers do not altogether agree upon is the method of applying a patch to the bottom of a tubular boiler. Some boilermakers believe in applying a patch inside the

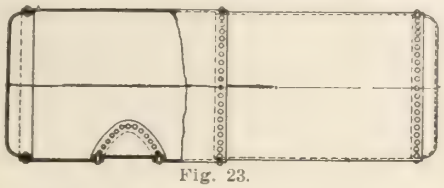


Fig. 23.

boiler as shown in Fig. 23, while others believe in applying the patch on the outside of the boiler as shown in Fig. 24. The latter practice, however, is more universally used than the former practice, and this notwithstanding the fact that a place or recess is created for the collection of mud and foreign substances.

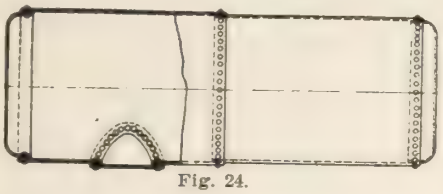


Fig. 24.

A patch applied to the bottom af a tubular boiler, whether applied inside or outside of the boiler, should never be applied with patch bolts. Patches can be readily and safely applied with patch bolts to the fire-box or furnaces of locomotive boilers—and for the reason that there is but little strain on the plate from the centre of the rivet hole to its edge. This is not true, however, with a patch as applied to a tubular boiler, per Figs. 23 and 24. They should be riveted.

The patch as applied in the manner as shown in Fig. 24, can be brought "home"—that is, brought metal to metal against a shell plate, more tightly than if applied in the manner as shown in Fig. 23, Further, the installation of the patch, Fig. 24, can be more readily and cheaply installed than the patch, Fig. 23, and practice has shown that it is

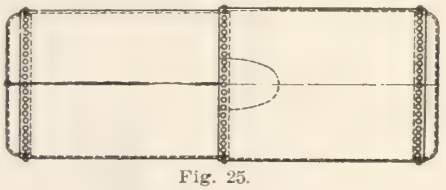


Fig. 25.

better to calk patches to the shell plate instead of the shell plate to the patch. If the boiler is clean, as it should be, no difficulty should be experienced by mud and foreign substances collecting in the recess patch applied as shown in Fig. 24.

Reference has already been made to the cutting of hole for patch on the shell plate. Frequently the shell plate will crack adjoining the girth seam. In such cases the hole should be cut as shown in Fig. 25, and not as shown in Fig. 26—and for the same reason as given in regards to Figs. 21 and 22.

It is not practical to apply the patch to the inside or outside of the boiler and not cut out the defective part when said defective part is in contact with the flames or hot gases. A crack might develop in—say the dome—and in this case a patch could be applied over the crack or defective part without removing same. However, that portion of the shell plate of a tubular boiler in contact with the flame and hot gases, should not and cannot be repaired by applying a patch without removing the defective part of the shell plate. If the patch is applied without removing the defective part, the double thickness of the plate at that point will result in the plate becoming overheated and the patch's length of service will be of a very short duration—

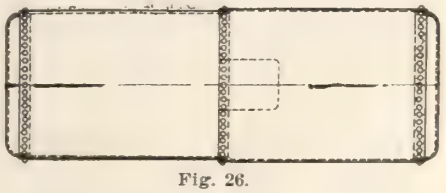


Fig. 26.

less than a day. It is very essential that the underlying principles of the foregoing should be understood, and when understood the repairing of boilers will be a simple matter.

*Fourth of a series of articles on this subject. Copyright by the MacLean Publishing Company.

Knight Diesel Engine. The mainshaft is connected to Eccentric Shaft Operating, Internal Sleeve Valves by Coventry Noiseless Drive Chain. John Miller & Son, Canadian Agents, Montreal.

The Efficiency and Durability of Silent Chain Drive

By K. Campbell

A Large Number of Silent or Noiseless Chain Drives Are Being Installed in Canada. There Are Three Types, the Renold, Coventry and Morse, the Former Two Manufactured in England and the Last Mentioned in United States, Canadian Installation Being Made Through Canadian Agents. As the Transmission of Power is Often Attended with Great Waste, the High Efficiency of Chain Drive Which is Approximately 98 per cent., Has Resulted in Great Savings Being Made. This Article is to Call Attention to the Use of Silent Chain Drive for Engineers. Enigneers Should Investigate the Many Different Forms of Drive and Install the One That Will Give the Greatest Economy, When one is to be Installed.

THERE are many locations and conditions particularly suited for silent chain drive. In certain instances ropes, belts and gears are essential and will never be discarded. When large centre distances are required the conditions indicate a drive by belts or ropes. Another limitation is to transmit power at right angles. ON THE OTHER HAND WHERE STRAIGHT DRIVE IS REQUIRED AND WHERE THE CENTRES ARE TOO CLOSE FOR THE USE OF EITHER ROPES OR BELTS, CHAIN DRIVE IS THE ONLY ALTERNATIVE.

The advantages claimed for the silent or noiseless types are :

(1) Absence of sliding friction between link and tooth ; therefore, (a) Noise and wear are reduced to a minimum. (b) High efficiency and high chain speeds.

(2). May be run quite slack, even at short centres ; therefore, (a) Journal pressure is reduced. (b) Waste of power practically eliminated.

(3). Can be run in either direction.

(4). Can be run in hot or damp places.

(5). Gives an accurate ratio between driver and driven.

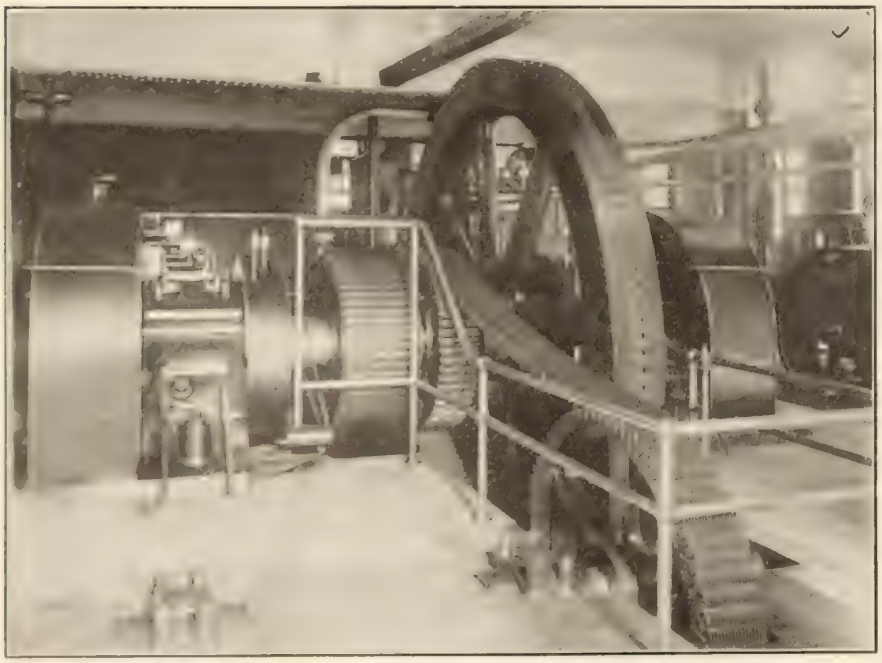
Efficiency.

THE EFFICIENCY OF CHAIN IS HIGH AND IS CONSTANT AT APPROXIMATELY 98 PER CENT., THE POSSIBILITY OF SLIP BEING ELIMINATED. There is therefore 98 per cent. of the engine or motor transmitted to the line shaft.

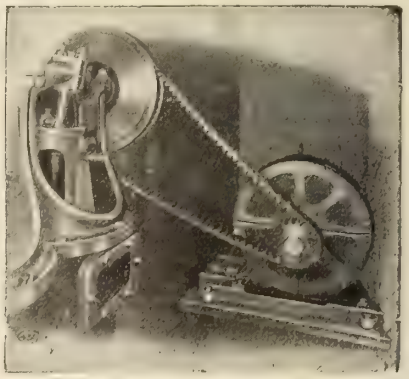
The chains make a durable drive, not being affected by moisture or oil. Chains carry large loads and there are a great number of drives installed which have been running for years. Under continuous service after several years the chains begin to wear, but for the reason that the chain automatically rises up the wheel as the pitch increases, the efficiency is constant.

Compactness, Costs, Etc.

SHORT CENTRE DISTANCES PROVIDE THE NATURAL FIELD FOR CHAIN DRIVES, their only competitor in such a case, being gears. In the matter of cost, chains are more expensive



Two Morse Silent Chain Drives, 1,000 H.P. and 500 H.P., Running 1,450 ft. per Minute.

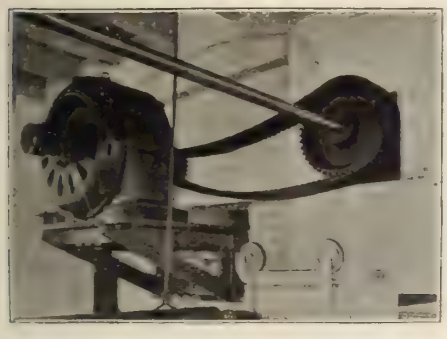


Spring Wheel Drive on 3-throw Edwards' Air Pump using Renold Chain for which Jones & Glassco, Montreal, are Agents.

than gears, but against this, tests concur in showing a higher efficiency for the chains, which, in plants of large capacity, leads to a constant saving of enough importance to justify placing it against the greater initial cost.

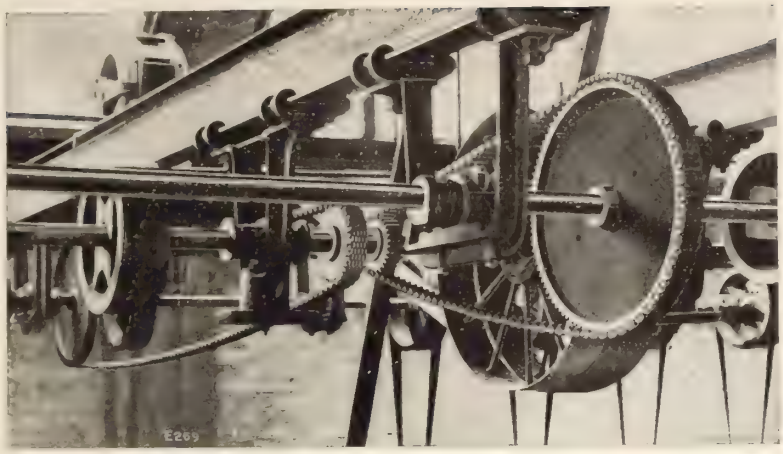
An illustration is shown of a 1,000 and 500 h.p. drive which runs smoothly at 1,448 ft. per minute. The drive in the foreground is the 500 h.p. with a chain 3 ins. pitch, 12 ins. face, with speeds of 95 and 75 r.p.m., sprockets with 61 and 77 teeth, and a centre distance of 135.32 ins. The 1,000 h.p. chain is of 3 inches pitch, but has a width of 24 inches. The speeds are 95 and 70 revolutions per minute, the sprockets have 61 and 83 teeth and the distance between centres is 103.24 inches. Both these drives were started in April, 1910.

In view of the newness of this system



Line shaft drive from motor using Renold chain; note there is no tension, the chain is sold in Canada by Jones & Glassco, Montreal.

of driving in such large units, our readers will be interested in the question of cost and it therefore may be stated that the cost per h.p. for chains and sprockets in the illustration to which reference has just been made is $3.98 and $3.67 respectively, these figures covering the chains and sprockets. The cost depends on the distance between centres as well

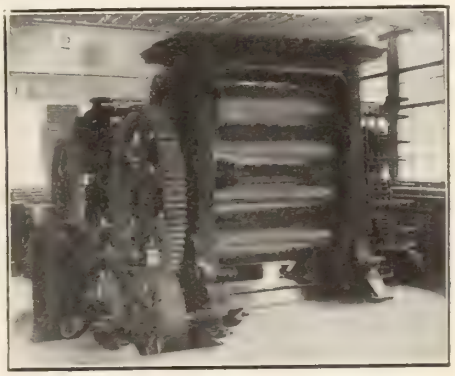


Shafting to Shafting Drive by Coventry Noiseless Drive Chain. John Millen & Sons, Canadian Agents, Montreal.

and for longer transmissions the cost will necessarily be higher.

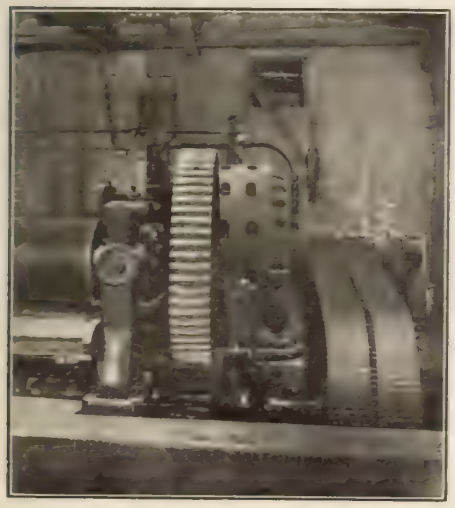
One of the most important considerations in main drives is the cost and time required to make replacements or repairs to insure continuity of operation. The usual forms of transmission as well as chains are probably equally free from the necessity of repairs, but in maintenance cost it is possible that chains will make the more favorable showing, since the wear between the teeth of the wheels and the links of the chain (which does not change the pitch) being so small, the wear limiting the life is that which takes place between the joints themselves and the gradual seating home of the joints in the links, which permits the chain to lengthen in pitch and climb higher and higher until nearly the top of the teeth is reached, when the chain requires repairs or renewal. With the links still in good condition this renewal does not require in even the largest chains more than ten to twenty hours, and is done by driving out the worn joint pins and inserting new pins enough larger to restore the chain to its original pitch length, at a cost of 10 to 15 per cent. of the first cost of the drive.

Compared with belt drive, the first cost is approximately 50 per cent. greater but THE EFFICIENT FEATURES OF CHAIN DRIVE, ESPECIALLY FOR SHORT CENTRES, SHOULD BE KEPT IN MIND. In addition to higher efficiency are saving in power, increased

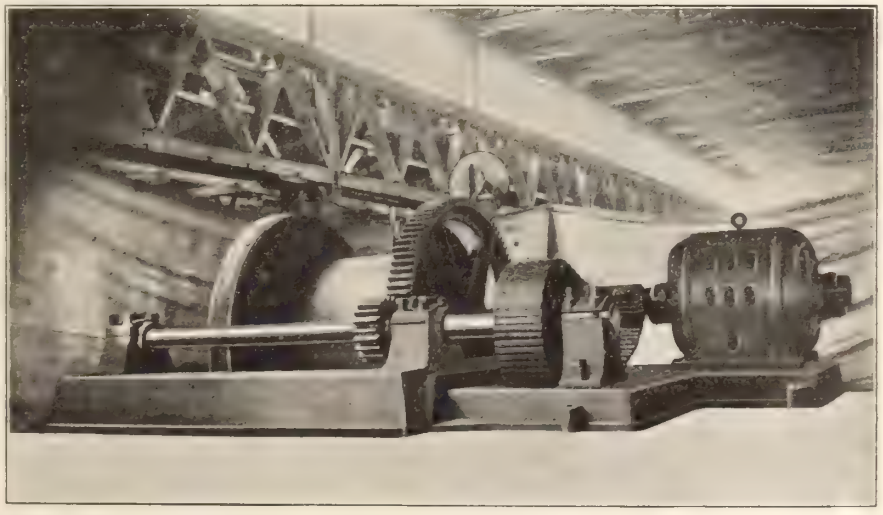


A 75 H.P. Silent Chain, with a Westinghouse Motor, Driving Calendar, Speed 1,450 ft. per Minute.

production, durability and the small cost of upkeep. There are many hundreds of drives now in use, many Canadian installations having been made and all giving good service.



A 200 H.P. Morse Silent Chain, with a Westinghouse Motor, Driving Rubber Washer, Speed 1,250 ft. per Minute.



Renold Silent Chain driving a mine hoist from a 150 h.p. motor. This is one of the comparatively heavy drives installed in Canada and was made by the Canadian agents for Renold Silent Chain, Jones & Glassco, Montreal.

Series of Practical Questions and Answers for Engineers

By A. E. B.

Every Care is Being Taken to Include Only Pertinent Practical Questions, and Give Same, Direct Reliable Answers. Catch Questions will be Avoided. The Knowledge of Simple Addition, Subtraction, Multiplication and Division of Decimals, Will be Found a Most Useful Companion Study, and Should Not be Overlooked.

58—Q. The driving pulley on a shaft is 42 in. diameter and makes 20 revolutions per minute. How many revolutions per minute will the driven pulley make if its diameter is 3 ft.?

A. Multiply the diameter of the driving pulley by its revolutions per minute, and divide the result by the diameter of the driven pulley. The pulley diameters must be both taken as feet or inches. Example:

$$\frac{42\times20}{36} \text{ or } \frac{42\times20}{12\times3} = 23.33 \text{ R. P. M.}$$

59—Q. If a horizontal boiler has 60 2-inch tubes, what should be the diameter of the chimney to properly carry off the smoke and gases, if a chimney equal in sectional area to the combined sectional area of the tubes is called for?

A. Reckoning the thickness of a 2-inch tube to be ⅛ inch, we have an inside diameter then of 1¾ inches.

The area of 1¾ inches diameter will be 1.75×1.75×.7854=2.4, therefore the area of 60 tubes will be 60×2.4=144 sq. inches.

The diameter of a chimney which will have an area of this amount is found by dividing 144 by .7854 and extracting the square root of the result. $\frac{144}{.7854}$ =183.35. The square root of 183.35=13.55 inches diameter.

Put in concise form, the method of arriving at the answer would be expressed as follows.

$$\sqrt{\frac{60\times1.75\times1.75\times.7854}{.7854}} = 13.55, \text{ say } 13\tfrac{1}{2} \text{ inches.}$$

60—Q. The wheels of a bicycle are 28 inches in diameter. The sprocket wheel connected with the pedals has 18 sprockets; the one connected with the wheel has 8 sprockets. How many miles an hour does the rider make if the pedals revolve 120 times a minute?

A. Multiply the pedal revolutions per minute by 60 to get revolutions per hour; multiply this result by the number of teeth in the pedal sprocket wheel and by the circumference in inches of the rear running wheel; then divide by the number of teeth on the sprocket attached to the latter and by 63360 the number of inches in a mile. Thus:

$$\frac{120\times60\times18\times28\times3.1416}{8\times63360} = 22.49 \text{ miles}$$

per hour.

61—Q. A gear has 25 teeth and its diametral pitch is 16. What is its pitch diameter?

A. The pitch diameter is found by multiplying 3.1416 by 25 and dividing the result by the diametral pitch 16 and by 3.1416, thus: $\frac{3.1416\times25}{16\times3.1416} = 1.5625$ inches pitch circle diameter.

The circular pitch is found by dividing 3.1416 by the diametral pitch 16, thus $\frac{3.1416}{16} = .19635$ inches circular pitch.

It will be noted that this last formula accounts for the first figures on the upper and lower lines of the first formula. The figure 25 on same formula is the number of teeth given; this multiplied by the circular pitch found, makes the pitch circle circumference. The divisor 3.1416 is used to bring the pitch circle circumference to pitch circle diameter.

62—Q. The diameter of a piece that is being turned is 2 in. If the piece makes 2,500 revolutions per minute, what is the cutting speed?

A. Cutting speed is always rated and spoken of in terms of feet per minute, therefore as the piece is being turned in amount equal to the length of its circumference, that length in feet wants to be first known.

$\frac{2\times3.1416}{12} = .5236$ feet per revolution.

2500×.5236 = 1309 ft. per minute, or

$\frac{2\times3.1416\times2500}{12} = 1309$ ft. per minute cutting speed.

63—Q. The milling machine countershaft pulleys driven from a line shaft are 14 inches in diameter and are to run 100, 200 and 150 r.p.m. respectively. Find the diameters of pulleys for the line shaft running at 200 r.p.m.

A. $\frac{14\times100}{200}$=7 inches diameter.

$\frac{14\times200}{200}$=14 inches diameter.

$\frac{14\times150}{200} = 10\frac{1}{2}$ inches diameter of line shaft pulleys respectively.

64—Q. How many revolutions per minute ought a piece of cast iron 3 inches in diameter be allowed to make if the cutting speed is usually 40 feet per minute?

A. Bring the cutting speed to inches by multiplying 40×12 which will give 480. This divided by 3×3.1416 the circumference of 3 inch diameter will give 50.9 revolutions per minute.

$\frac{40\times12}{3\times3.1416} = 50.9$. By keeping the cutting speed in feet, the statement of the formula to get the same result would be

$40 \div \frac{3\times3.1416}{12} = 50.9$ r.p.m.

65—Q. A certain grindstone will stand a surface or rim speed of 800 ft. per minute. At how many r.p.m. could it be run if its diameter were 4 ft. 8 in.?

A. Divide 800 by the circumference in feet of the 4 feet 8 inches diameter grindstone.

$\frac{800}{4.66\times3.1416} = 54.6$ r.p.m.

66—Q. What weight should be placed on a safety valve lever, of which the following accessory particulars are given? Length of lever 18 in. from fulcrum to inside of hooked end; distance of fulcrum to valve centre 3 in.; valve diameter 2¾ in.; boiler pressure 100 lbs. per square inch by gauge; upward pressure of steam necessary to lift valve and lever without weight, 20 lbs.

A. The weight required is found by multiplying the boiler gauge presure and the valve area together; subtracting from the result the upward pressure of steam necessary to lift valve and lever alone; multiplying the remainder by the distance between the valve centre and fulcrum, and dividing by the distance between fulcrum and desired position of weight on lever.

$$\text{Weight} = \frac{(100\times5.94)-20,\ \times3}{18}$$

$$= \frac{(594-20,\ \times3}{18}$$

$$= \frac{574\times3}{18} = 95.66 \text{ pounds.}$$

67—Q. Why is the fire grate a factor in determing the safety valve area of a steam boiler?

A. Because dependent on the amount of it, is the evaporative capacity of the boiler.

For example, a 20 sq. feet grate will evaporate more water than will a 10 sq. feet grate, other conditions being equal. The larger evaporation therefore needs larger provision for its relief when occasion arises.

68—Q. Why is the steam pressure a factor in determing the safety valve area of a steam boiler?

A. Because increased pressure means increased velocity and decreased volume, therefore the steam escapes quicker and a smaller outlet area suffices.

69—Q. Two boilers alike in respect of steam pressure and grate area; one operating under forced draft and the other under natural draft, require to be provided with safety valves. Would the same size be sufficient in each case?

A. No; that with the forced draft would require a larger area of valve, because the evaporation would be much more rapid due to a greater consumption of fuel in a given time.

Explanation of Principles Involved in Answers to Questions

By Pedestal

The Bolstering up of Oneself With the Memorizing of a Series of "Don'ts," With Bald Knowledge Given of What You Should do, and the Cramming of Your Head With "Kinks," Will be of Little Service in Enabling You to "Hold Down" a Position, if You Have Neglected to Add Intelligence to Your Knowledge. Many a Child Can Repeat the Alphabet, but Cannot Distinguish One Letter From Another. In This Series we Aim to Help You.

PUMP DATA.

THEORETICALLY a pump will draw water from a depth of 33.96 feet. This amount is obtained by multiplying 14.7 pounds (the atmospheric pressure

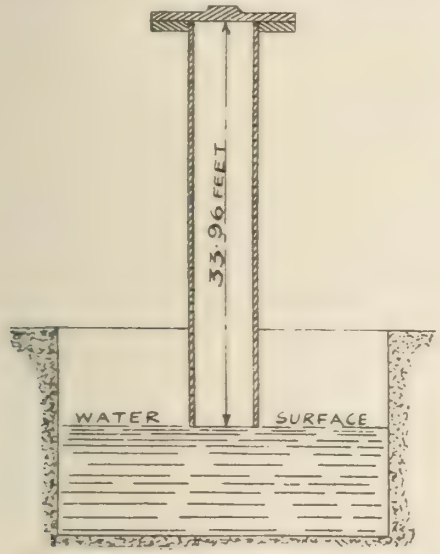


Fig. 15.—Theoretical Pump Suction Lift.

to be eliminated in order to get a perfect vacuum) by 2.31 which is the head or depth in feet necessary to produce a pressure of 1 pound per sq. inch.

The sketch Fig. 15 represents a pipe 33.96 feet long, with its open end resting on water which is subject to atmospheric pressure. If the air be extracted between the water surface and the closed end of the pipe, producing a perfect vacuum, then the water will rise and fill the pipe.

In practice, however, a perfect vacuum is unattainable because of valve leakage, vapor and air contained in the water, therefore the suction lift as it is called comes usually under 30 feet as a result.

The higher the water temperature the less still will be the suction lift, due to higher pressure of the vapor, and for what we term hot water, no attempt at suction need be made. Rather must a gravity flow to the pump be arranged.

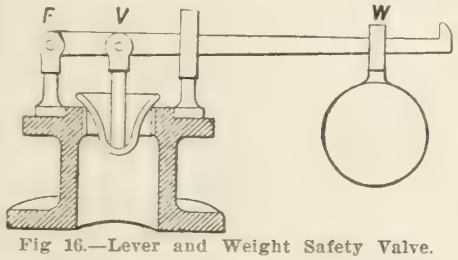


Fig 16.—Lever and Weight Safety Valve.

SPRING TYPE SAFETY VALVES.

The British Board of Trade rules referring to the area of safety valves constitute a thoroughly reliable method by which these important accessories of steam boilers may be determined.

With natural draft, the area of the locked-up safety valves in sq. inches should equal 37.5 x grate area in sq. feet, divided by the absolute working steam pressure of the boiler.

With forced draft the corresponding safety valve area should equal that calculated for natural draft multiplied by the estimated coal consumption in pounds per hour per sq. foot of grate and divided by 20.

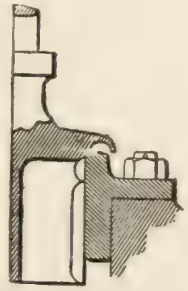


Fig. 18—Safety Valve and Seat, With Lip or Overhang.

The 37.5 in the natural draft calculation is a constant number deduced from test and experiment, while the 20 in the forced draft calculation refers to a not uncommon natural draft coal consumption per sq. ft. of grate per hour.

Fig. 16 is a sketch of a lever and weight safety valve, the letters F, V, W, representing the fulcrum, valve and weight respectively.

Fig. 17 is representative of the spring loaded type of safety valve, and has as will be noted, no lip on the valve. Fig. 18 shows in section the detail of a safety valve and seat, the former having lip or overhang. The purpose of this lip or overhang is to provide a second contracted opening at the outer edge.

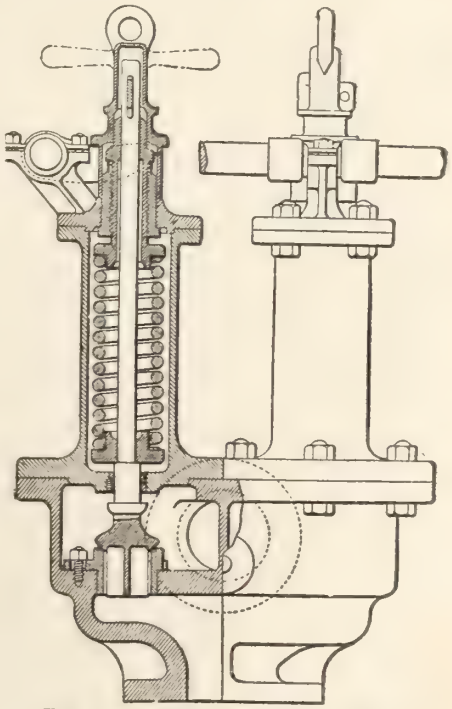


Fig. 17.—Spring Type Safety Valve.

Correspondence

Discussion on Previous Articles—Readers' Queries and Comments. Remuneration for useful Ideas

EDITOR'S NOTE.

On account of the large number of replies received to the queries of G.F.H., Millbrook, Ont., B. E. T., Toronto, and O. R., Lethbridge, Alta., we have been compelled owing to limited space to restrict their publication to one of each only. Those from whom replies were received are as follows:—Samuel Worthy, Hamilton, Ont., Hugh M. Hunt, Montreal, and R. McLaren, Berlin, Ont.

The correspondence received on the boiler design and construction discussion has for the same reason been omitted in this issue.

REPLIES, H. M., WINNIPEG.

H. M., Winnipeg, has omitted to give the weight of valve and lever; distance from fulcrum to centre of gravity, but states that 20 lbs. balances lever and valve. I understand he means a total upward pressure of 20 lbs. The area of the valve is 5.9396 square inches, and a boiler pressure of 3.5 lbs. per square inch will just lift the valve. The total upward pressure on the valve with 100 lbs. boiler pressure will be 594 lbs., and the total downward pressure will be the weight multiplied by the ratio of length of lever from centre of valve to end, and length from fulcrum to valve centre. This will be 18 to 3, or 6 to 1. This ratio divided into the total upward pressure will give the weight.

$$\frac{594}{6} \text{ equals } 99 \text{ lbs.}$$

As every 5 lbs. under the valve means 1 lb. on the end of lever, 4 lbs. must be deducted from the weight to compensate for the 20 lbs., due to weight of lever and valve. This method is not absolutely correct, but gives the weight closely. Very seldom any lever valve will lift at the calculated weight, owing to friction and other causes.—J. C. Tweedale.—See Q. and A. 66.

REPLIES, O.R., LETHBRIDGE, ALTA.

H. Prew, Montreal, says that one could give more definite information if more particulars had been given in reference to exposure, glass area, etc.

A-1.—Reckoning 1 sq. foot for every 100 cubic feet, we get 800 sq. feet and taking steam at atmospheric pressure it is found by experiment that 1.8 heat units are given off per sq. ft. radiating surface per degree difference between the inside of radiators and outside temperature per hour under normal conditions. Now 800 sq. ft.$\times$1.8$\times$142$=$ 204.480 H.U. given off. 204.480$\div$966 the latent heat of steam$=$212 lbs. water per hour. To be on the safe side say 230 lbs. As one lb. steam at atmospheric$=$ 26.36 c. ft., then 26.36$\times$230$=$6062 c. ft. 6062$\div$(60$\times$60)$=$1.68 per second. Allow a velocity of 25 ft. per second or 1,500 per min. 25$\div$1.68 $=$ 15 nearly. 144 sq. in. $\div$ 15 $=$ 9.1 sq. in. required.

$\sqrt{9} = 3$ and 3$\div$.7854 $=$ a 4 inch pipe. A 4 inch pipe would be ample and allows for line losses.

A.-2.—Radiators will be the best for offices; pipe coils are more suitable for factories.

A.-3.—Direct radiation.

A.-4.—A steam trap would certainly be necessary, it would be sheer waste of money to blow steam and hot water to the sewer.

A.-5.—A blow-down tank or well though not absolutely necessary has so many advantages in its favor and it can be constructed so cheaply that it would be poor engineering to be without one.

Room temperature in answers 1, 2, 3, is taken at 70 degrees F.

REPLIES, G.F.H., MILLBROOK, ONT.

A.-1.—G. F. H., Millbrook, does not state what kind of a joint, whether lap or butt. We will assume it is a butt joint, double strap and double riveted. Assuming an efficiency for the joint of 80 per cent., the following formula will give the working pressure if the boiler is new.

$$\frac{TS \times \% \times (2 \times T)}{D \times F}$$; TS$=$Tensile strength, % $=$ efficiency of joint, T $=$ plate thickness, D $=$ diameter of boiler, F $=$ factor of safety. Taking a factor of safety of 5, and a joint efficiency of 80 per cent., working pressure equals.

$$\frac{60000 \times 80 \times 2 \times .318}{50 \times 5} = 122.112 \text{ lbs. per sq. in.}$$

A.-2.—If the boiler is out of commission 6 or 8 hours and open during that time, it should be fairly cool, and cold water under these circumstances should not seriously affect it. In most plants with only one boiler, the engineer, after washing out, has nothing else but cold water to fill up with.

A.-3.—Yes, it has. By referring to a set of steam tables, it will be seen that steam at 40 lbs. gauge pressure has a temperature of 287 degrees nearly, whilst steam at 100 lbs. pressure has a temperature of 337 degrees. Since the water is in the same vessel as the steam it must necessarily have the same temperature.

A.-4.—Percentage does not enter into the question. What is implied is that 8 parts by weight of oxygen and 1 part by weight of hydrogen constitute water.

A.-5.—Pitting and honey-combing in a boiler plate are readily seen. The plates are indented in spots with holes and cavities from 1-32 in. to $\frac{1}{4}$ in. deep.

A.-6.—In lining up an engine, first remove piston, piston and connecting rod and crosshead. Level the frame lengthwise by placing a level on the lower guide and levelling with iron wedges. Now place level on the shaft to get it level by adjusting the outer bearing. Having done this, stretch a line through the cylinder from the back end to the front beyond the crank pin. Take a board and bore a small hole in it, pass the line through and fasten it, lay the board across the cylinder end, and secure the line to a board at the other end so that it can be adjusted to any position. Measure the line from the back making certain that the line is in the centre of cylinder bore. Then measure the line coming through stuffing box and see that it is central. Turn crank pin to one centre and see if the line comes over the centre of crank pin. Adjust outer bearing till it does. Turn to the other centre, and if the lining has been properly done, the crank pin will be over the centre of the line. The frame is now level. The shaft is also level and will be at right angles to the connecting rod. The joint or space, if any, between the frame and foundation can be filled with a good cement mixture, and the holding down bolts tightened up.

A.-7.—In a slide valve the compression is controlled by the amount of inside lap. Increasing the inside lap causes the exhaust port to close earlier on the return stroke, thus trapping the steam that remains in the cylinder. As the steam is now forced or compressed into smaller volume, the pressure rises and acts as a cushion to bring the piston to rest, and also fills the clearance

spaces with steam which would otherwise have had to be supplied by live steam from the boiler. It will be seen that compression serves two purposes. It assists in bringing the piston to rest and fills the clearance spaces, thereby adding to the economy of the engine.

8.-A.—The reason why a pump will not lift hot water is, because the vapor and steam rising from the water destroy the vacuum which the suction of the pump creates. In other words, to raise water at atmospheric pressure in a pipe, the pressure must be reduced below that pressure. The pump does not lift the water; it reduces the pressure or pumps the air out of the pipe and the air pressure outside forces the water up to the pump, if cold water.

9.-A.—The tensile strength of a boiler plate is accurately determined by means of a testing machine. This machine is arranged so that the pull on the test piece in pounds can be read from a gauge or easily calculated. The test piece is usually about 9 inches long, exactly one inch wide and planed on both edges. It is also divided into inch divisions with a very light punch mark, so that the elongation between any two marks can be noted. The ultimate tensile strength is the pull in pounds at which the plate pulls apart. It is calculated from a plate one inch thick and one inch wide.—J. C. Tweedale.

REPLIES, B. E. T. TORONTO.

A.-1.—It will depend entirely on the pressure of the water leaving the discharge pipe. Theoretically, the water should rise to a height vertically equal to the head of water from which it is supplied. That is to say, if a pump discharges water at 100 lbs. pressure per sq. inch, the water should rise to $100 \times 2.31 = 231$ feet high, but owing to the resistance of the air, friction, and the effect of the falling particles of water, this can never be realized.

A.-2.—The reason why an injector puts water into a boiler is based on the fact (discovered by Gifford) that the motion supplied by a jet of steam to a column of water is sufficient to force it into the same boiler from which the steam is taken. This steam escaping under pressure has a much higher velocity than water would have under the same conditions. Steam at 60 lbs., when discharged into the atmosphere has a velocity of about 1,700 feet per second. When discharged at this velocity through say a one-inch pipe, the steam encounters the water in the combining chamber which immediately condenses and reduces its bulk considerably, but its velocity remains practically the same. Uniting with the water in the combining tube, the water receives a large share of the velocity of the steam, and the body of water thus set in motion, operating against a comparatively small area of boiler pressure, is able to overcome it and flow in.

A.-3.—It depends on the type of engine and the method of governing. If controlled by a fly-wheel governor, the eccentric is fastened to the governor arm and not to the shaft. Engines of the Ideal and Robb-Armstrong type are connected this way by means of studs, or cap screws, and should they come loose, it will be apparent by the noise and rattling in the governor wheel. The remedy is to tighten up the cap screws holding the eccentric to the governor arm. In the case of an eccentric becoming loose and slipping on a Corliss tpye of engine (the eccentric is fastened to the shaft of the engine in this type), a quick method of resetting is to place the engine on one centre, roll eccentric round the shaft until the steam valve is open about 1-32 in. or more, according to the size of the engine. If piped for indicator, open the valve on that and then admit a little steam, when, if the steam valve is open at all, steam will issue from the valve on the indicator pipe. Turn engine to the other centre, and open the indicator valve on that end, and if steam comes out when the throttle is cracked, tighten set screws in the eccentric. The engine should be able to run until there is time to indicate and set the valves accurately, at the first opportunity. If the eccentric is keyed on to the shaft, there is only one position for the eccentric. Roll it round till the key ways of eccentric and shaft coincide; then slip the key in and tighten up set screws.—J. C. Tweedale.

Personal and Societies

A bill to regulate the issuing of certificates in New Brunswick has been introduced in the New Brunswick legislature.

* * *

The Electrical Club has been organized at Winnipeg with W. H. Brown as recording-secretary.

* * *

The Ottawa Lodge, No. 7, C. A. S. E., at a recent regular meeting, 325 Dalhousie St., Ottawa, was treated to a talk by Bro. Boyce, boiler inspector, on the strength of joints and boiler formulae. He gave examples from his own experience of faulty brick boiler settings and their effect on joints. The strength of rivets, thickness of plate, etc., were also discussed. After the lecture a heartfelt vote of sympathy was tendered Bro. H. Creagon who recently suffered the loss of his wife. Secretary C. J. Lake was instructed to forward the testimony of sympathy to Mr. Creagon. Bro. F. J. Merrill occupied the chair.

The Manitoba Association of Stationary Engineers has now a permanent secretary, A. R. Parkinson, Box 1412, Winnipeg.

* * *

On April 6, the stationary engineers of St. John, N.B., decided to organize a lodge in affiliation with the Canadian Association of Stationary Engineers. The officers elected were: President, W. A. Cooper; vice-pres., S. Dunham; secretary, Frederick Latham and Treasurer, Frederick Watson.

* * *

H. Etches, mechanical engineer and draftsman, has removed his office to 17 Bank of Hamilton Bldg., 34 Yonge St., Toronto. He was formerly chief draftsman with Carnegie Steel Co., Pittsburg; Waterous Engine Works, Brantford; Dodge Mfg. Co., Toronto, and Hanley & Miller, Toronto. His special line is designing special machinery, making working drawings, and general designing work.

* * *

The sudden death occurred on March 19th, whilst on the train between Montreal and Sydney, C.B., of Major Walter H. Laurie, senior partner of the firm of Laurie & Lamb, engineers, Montreal. In his profession as an engineer, Mr. Laurie was well and favorably known. He was one of the founders of the Engineers' Club in Montreal and was also one of the older members of the Canadian Society of Civil Engineers. The business of the firm will be carried on as usual under the management of Albert Laurie, son of deceased, who was also a member of the firm.

CANADIAN MANAGER MAGNOLIA METAL CO.

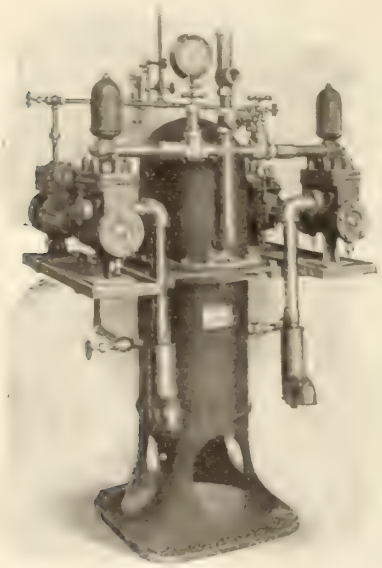
Many Canadians, particularly old McGill University boys, will be interested to know that F. L. W. Saunderson has been appointed the Canadian manager of the Magnolia Metal Co., with factory and offices located in Montreal, and whose connections and business are world wide. Mr. Saunderson graduated at McGill University in class of 1891, taking a course in electrical engineering and afterwards took a special practical electrical course with the Thompson-Houston Electric Co., at Lynn, Mass., and for the past fifteen years has been identified with the mill supply business in Canada. He enters upon his new duties well equipped to insure that the prominent interests entrusted to him will be cared for and advanced. Mr. Saunderson is widely known and prominently connected throughout the Dominion; his father, C. E. Saunderson, prior to his decease, was senior partner in the well known Montreal firm of B. & S. H. Thompson, and his brother, A. O. Saunderson, is at the head of the Saunderson Mfg. Co., of Sydney, N.S.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

TRANSMISSION OF OIL.

At the new Toronto plant of the Standard Sanitary Mfg. Co., there there has been installed a system of pumping the fuel oil from the receiving tank to the three furnaces in the



Pump for Transmission of Oil.

cleaning house, six furnaces in the enamel building, and two melting furnaces in the mill building. Provision has been made for the doubling of this number of furnaces.

Each furnace is equipped with Kirkwood burners. The air for the furnaces is generated by the Rand Air Compressor described in the March issue of The Power House and the air and fuel oil are piped through a tunnel which connects all the buildings with the power house and in which all piping is located.

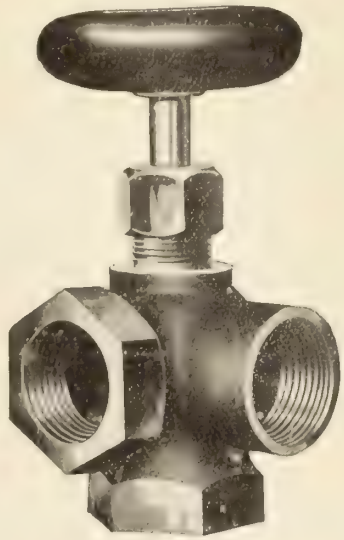
The three oil tanks are situated on a railway siding and the pump shown herewith is supplied by Tate, Jones & Co., Pittsburg, Pa. By means of the by-pass or clean-out pipe all the oil in the line and pumping system may be drained back to the tank when the plant is shut down, conforming with the insurance regulations.

DETROIT 3-WAY VALVE.

The Detroit 3-way valve consists of a globular body with three openings—one at the base through which the water enters and two at the sides, at right angles to each other. The shell is so arranged that all of the water coming up through the opening in the base can be turned through either one of the side openings or it can be graduated to divert any required volume of water through either of the openings and turn the rest through the other hole. The handle is indexed and shows what proportion of water is passing through each opening.

The tapering shell takes up any wear occurring in the valve. The spring in the bonnet of valve holds the conical shell up to its seat, at the same time exerting a downward pressure on the small rubber washer slipped over the stem and held within the chamber in the cup of the valve. The pressure of the spring expands the rubber gasket, making it "self-packing." This valve is threaded for either $\frac{1}{2}$" or $\frac{3}{4}$".

The valve is used on water cooled gas and gasoline engines to turn the necessary amount of water into the water cooled muffler or exhaust, after it has



Detroit 3-Way Valve, Made by Detroit Lubricating Co., Detroit.

passed through the water jacket on the cylinder, and turning the rest of the water overboard.

The 3-way valve is manufactured by the Detroit Lubricator Co., Detroit.

ESCHER WYSS AND COMPANY.

The Escher, Wyss Company, of Zurich, Switzerland, have opened a Canadian office in the Lumsden building, Toronto, under the management of their chief engineer Mr. Theo. Heyerdahl. This company have a world-wide reputation in the field of hydraulic engineering, having been founded as long ago as the year 1807.

The growing importance and extent of the Canadian contracts already on hand and the immense possibilities sure to arise as the development of the Dominion proceeds, are in the firm's estimation reasons sufficient for having a fully equipped staff on hand to deal with the numerous and various inquiries as they arise. Contracts in various parts of the world at first of March, this year, amount to 400,000 horse power, comprising among others 2-13,000 h.p. turbines for the Western Canada Power Co., Vancouver, B. C.; 6-10,000 h.p. turbines for S. Pearson's successors, Mexico; 6-12,000 h.p. turbines for Tokyo, Japan; 4-4,600 h.p. turbines for the Sao Paulo Power Co., Brazil, and 4-5,000 h.p. turbines for the German Swiss Water Power Co., Bales. High pressure turbines or impulse wheels with pressures ranging from 150 to 3,100 feet, and Francis turbines with pressures ranging from 1 to 650 feet cover the field already supplied, and as will be noted deal with a wide range of requirement.

THE TWENTIETH CENTURY GRATE BAR.

A new grate bar has been placed on the market by the Boiler Repair and Grate Bar Co., 69 Adelaide St. East, Toronto, known as the 20th Century Shaking and Dumping Grate Bar. Fig.

ADAM H. HETT.

of the Boiler Repair & Grate Bar Co., Toronto, Who Has Been Connected with the Boiler Business for 33 Years.

1 shows the top and side view of bar. This shows the channel sections and V-surface of truss. Fig. 2 shows the bottom and side view of bar. This illus-

tration gives an idea of the depth of the sections from top to bottom.

The claim made for this grate is increased air space and long life of bar due to the transverse sections. These

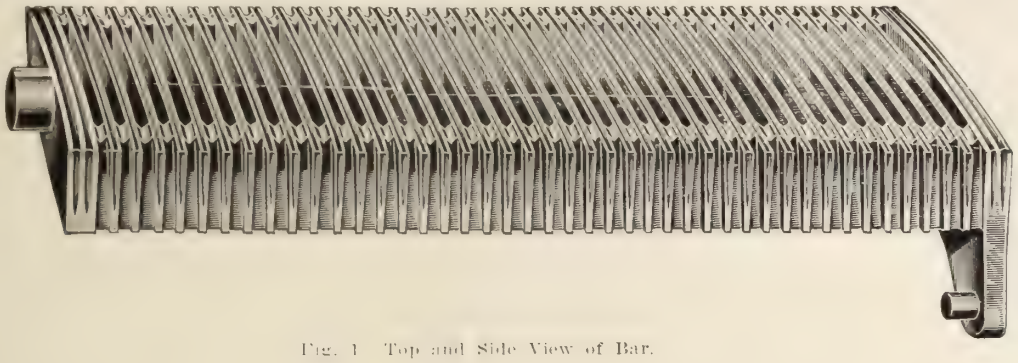


Fig. 1—Top and Side View of Bar.

two features allow the burning of low grade fuel with economical results. Among the installations that have been made are twenty-four sets in the brick plant of Bell Bros., Toronto.

The Boiler Repair and Grate Bar Co. intend carrying on a business of Boiler Repair. The grate department will be in charge of J. E. Taylor while the boiler repair will be in charge of A. H. Hett, who has been boiler repairer for the Lang Tanning Co., Berlin, and other companies. They have on hand a large number of special tools which are required in boiler repair work so that work entrusted to them will be quickly and efficiently completed.

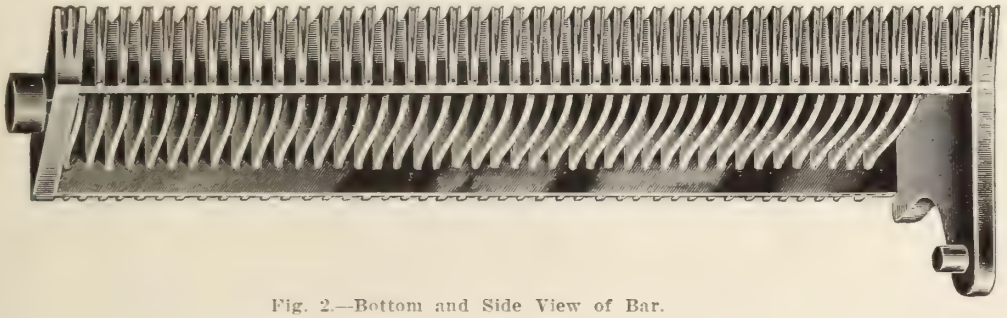


Fig. 2.—Bottom and Side View of Bar.

KENYON PATENT INTER-STRANDED COTTON DRIVING ROPE.

IN Canada rope driving is not so generally used as in the United States, Great Britain or Continental Europe, perhaps by reason of the fact that the majority of the most important manufacturing plants are, comparatively speaking, of such recent construction that Electric Power has been available and motors have been installed for driving different sections of the plant, where 10 or 15 years ago steam engines were used for developing the power and gears or ropes for distributing same. Assuming that this is the case, there is still, however, a considerable field in the transmission world for rope driving, and in this article after dealing briefly with the two systems of rope driving at present in use, it is our intention to describe in detail the patent inter-stranded cotton rope, manufactured by Wm. Kenyon & Sons, Ltd., Dukinfield, Eng., for whom Jones & Glassco, Montreal, are sole Canadian agents.

Rope Driving Systems.

Rope driving may be divided into two leading branches known as the "American" or continuous and the "English" or individual rope system.

The continuous rope system, that of winding one long rope as many times round driving and driven pulleys as there are grooves to fill, and then carrying it across the whole width of both by means of a jockey pulley, may possess certain advantages under special conditions, as for example the driving of paper-making machinery by a series of expanding rope pulleys, so arranged as to permit a variation at the driving line of about 4 inches in their respective diameters. But under the ordinary conditions governing power transmission, the comparative imperfections of the method are so pronounced that numerous installations have been transformed to multiple ropes with most beneficial results. The principal objections to it are that the rope presses harder against one side of the grooves than the other causing uneven wear; the tension pulley is not only destructive to the rope, but involves considerable waste of power, and perhaps most important of all, the satisfaction of the entire drive depends on a single rope, and in the event of the rope breaking there is a risk of it becoming hoplelessly entangled with shaft-

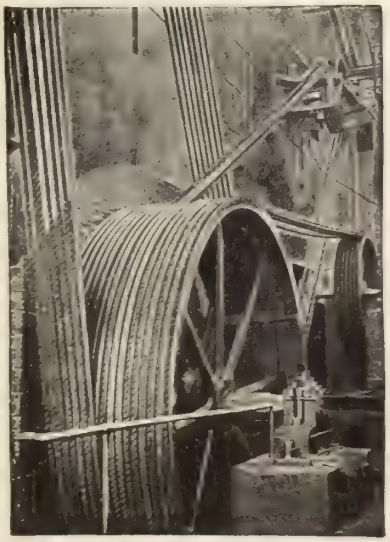


Fig. 1—Typical Rope Drive, "English" System

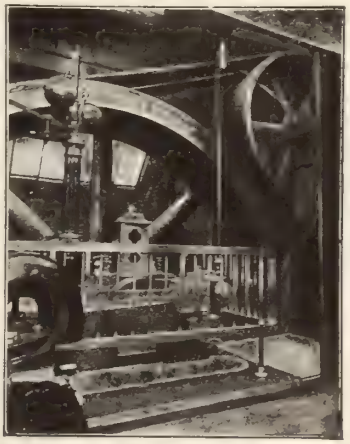


Fig. 2—300 H.P. Rope Drive, Pulleys 8 ins. Apart.

ing and machinery, while the entire drive is brought to a stand until it can be repaired.

The "English" or individual rope

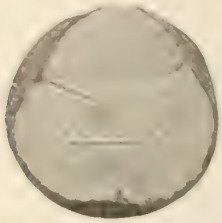


Fig. 3—Section of Three-strand Cotton Rope Showing Triangular or Wedge Form

system consists of using independent circular grooves with a separate rope for each groove. This system is most generally used in Great Britain and on the continent; no tension carriage is required and it has many advantages over the continuous system, the principal being that should one rope break the other ropes provide a sufficient margin to carry on the work, and in many cases it is not necessary to shut down the works at all, the defective rope being merely removed from position until such time as it is convenient for repairs.

Fig. 1 shows a typical drive on the "English" system and Fig. 2 shows how 360 h.p. is transmitted by cotton driving ropes between pulleys only 8-in. apart. This latter drive replaced an unsatisfactory spur gear drive, the rope pulleys being fixed upon the same centres.

Did space permit it might be of interest to our readers to discuss the advantages of ropes having different numbers of strands, but as it is generally acknowledged that three strand ropes have greater driving force than all others, we will proceed to decribe the Kenyon Patent Cotton Rope of this construction. Each of the three strands is made up of a succession of sheaths or layers of yarn which may be peeled off one by

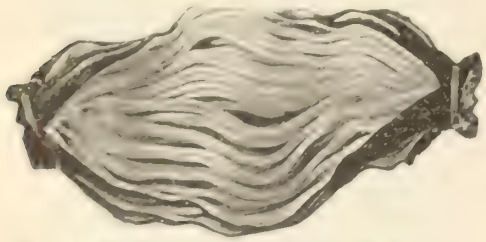


Fig. 4—Effects of Regular Lay and Tension in the Kenyon Method of "P.I." Cotton Rope.

one till the last section is reached. The constantly increasing bulk due to the laying on of these concentric rings has the effect of lengthening the yarns of each succeeding layer in corresponding gradations, so that one taken from the outside of a strand in a rope 1½ inches diameter is nearly 18 per cent. longer than that taken from the centre

The difference of course being greater in a thicker rope.

This inter-stranding process also ensures a more compact mass of fibres

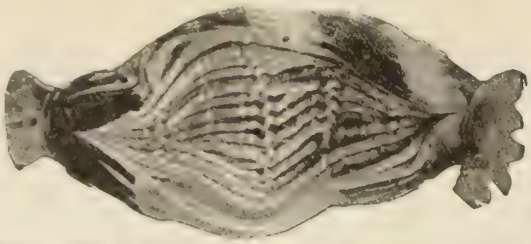


Fig. 5—Crinkling seen in all Driving Ropes made on Ordinary Method, Causing them to stretch considerably when working.

than may be compressed into the same area by any other process, thus securing a higher breaking strain, greater driving force and longer life besides immunity from undue stretching.

The result of even lay and tension is well manifested in the open strand of a "P.I." rope as per Fig. 4, if compared with the inside of a strand upon which no such care in construction has been bestowed. The result of this malconstruction is to be seen in the crinkling up (Fig. 5) of the inner yarns, at the expense of straining the outer ones, which must soon yield under driving stress and release by degrees the less taut yarns below the surface, themselves providing ample scope for extension so that frequent tightening becomes a disagreeable necessity.

There is practically no limit to the length of this make of driving rope except convenience for transit, which is an undoubted advantage for large installations where it may be necessary to maintain stock against breakdowns or indeed for export purposes. The largest coil hitherto made upon this principle contains 12,120 feet of $1\frac{5}{8}$ inch diameter rope, which secured the gold

Fig. 6—Mill Interior, where Ring Frames are Driven with Kenyon Ropes on their Fast and Loose Rope Pulleys.

medal at the recent Franco-British Exposition.

Frequently the question arises as to the effect of atmospheric changes on cotton ropes exposed to the weather. It is, of course, better both for the ropes and drive to be under cover of some kind, but the makers of this rope have no compunction in recommending cotton ropes in preference to manila, when the location is an exposed one, as moisture readily evaporates through the fibres of cotton, although they are also absorbent in character, while on the other hand manila or hemp of any kind retains moisture and mildews internally in consequence. Messrs. Kenyon & Sons do not recommend the application of anything to the ropes by way of protection from damp, particularly such dressings as are likely to close up the pores. This contention is borne out to a remarkable degree in the driving of "Tailing Wheels" employed for washing ore. These ropes besides constantly working in water and grit are entirely exposed to the weather and the life of cotton ropes is upwards of six times as long as the life of manila rope working under identical conditions.

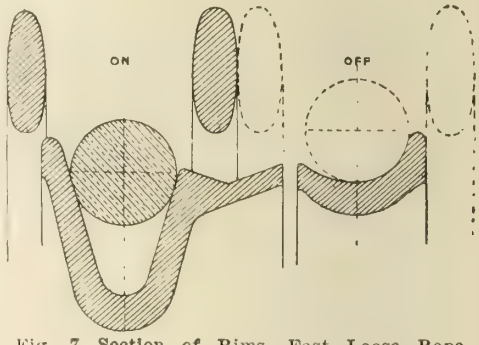


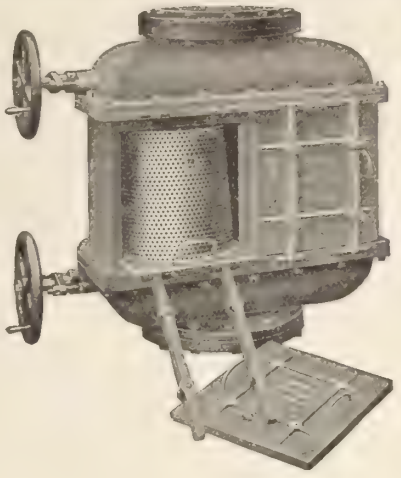
Fig. 7—Section of Rims, Fast Loose Rope Pulleys.

The adaptibility of rope driving for individual machines is shown in Fig. 6. Here it will be observed power is conveyed from a lineshaft running the whole length of a room to numerous ring frames for spinning cotton by means of ropes instead of belts. To what extent the weight upon the shafting is relieved by the substitution of ropes will be appreciated when it is stated that belts $3\frac{1}{2}$ inches wide are usually employed for ring frames, while the ropes are only 13-16 inch in diameter. Fig. 7 shows a simple combination of fast and loose rope pulleys, which in addition to being extensively used in the cotton trade, are also attached to the overhead gearing of lathes, mortar mills, milling, and in fact almost every class of machinery requiring inconstant rotary motion.

It will be observed that a shallow intermediate groove is turned upon the fast pulley, in which the rope revolves a few revolutions before passing to its full work. This ensures a gradual start or knock-off when required and provides against sensitive action.

Jones & Glassco, Montreal, kindly furnished the cuts for this article.

Protect Your Valves and Injectors



from untold damage by ice, twigs, slush and other matter in your water by installing a

Twin Strainer

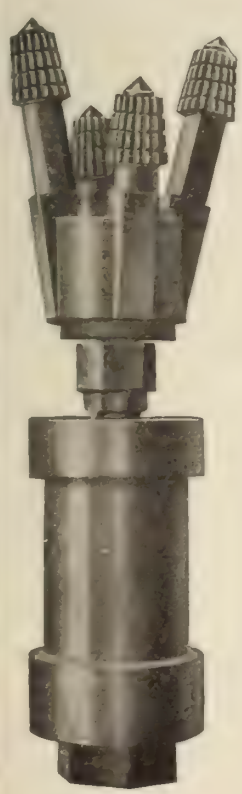
You will be astonished at the amount of foreign matter the "TWIN" intercepts, and prevents from going into your plant.

Either side of the "TWIN" Strainer can be cleaned without shutting off the other, thus giving an uninterrupted flow of water.

Investigate the merits of this wonderful trouble-saver.

WRITE TO-DAY FOR ABRIDGED CATALOGUE

Elliott Company 6902 Susquehanna Street **Pittsburg, Pa.**



Boiler Scale is Dangerous and Expensive

and its formation on your boiler tubes means a certain increase in your coal bills. It has been proved that ONE-EIGHTH of an inch of scale means a fifth decrease in efficiency, and a quarter more coal consumption than should be needed.

Keep your boiler tubes free from scale by using a

Liberty Tube Cleaner

operated by air, steam or water. It removes scale in a rapid and efficient manner, and thereby lessening the danger of burned-out tubes.

Give this proposition your best consideration. It will pay you handsomely.

SEND TO-DAY FOR NEW CATALOGUE

LIBERTY MFG. CO.

6902 Susquehanna Street - - PITTSBURG, PA.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

BRITISH COLUMBIA.

VANCOUVER—An artificial ice rink will be [illegible] this summer.

VICTORIA—Frank Patrick, Nelson, B.C., is interested in the artificial rink that will be [illegible] this summer.

VANCOUVER—The Wallace Fisheries, Ltd., of this city, have acquired the canneries of [illegible] and others owning plants on the north coast. They have acquired the cannery of C. A. Ternan at Uchucklesat on the west coast of Vancouver Island. At this latter place a cold storage plant with 1,500 tons capacity will be erected.

COQUITLAM—The Government Asylum Farm is having installed a 2½-ton refrigerating plant for cooling provisions in storage.

MILLSIDE—The Fraser River Mill Co., has had installed a 5-ton Wolf, Jr., refrigerating plant.

SARDIS—The Edenbank Creamery Co., of Vancouver, is having its branch in this town equipped with a 5-ton refrigerating machine and 1-ton ice making system, Wolf, Jr., ma[illegible] installed by the Pacific Heating & Refrigeration Co.

ALBERTA.

EDMONTON—P. Burns will erect a packing plant here.

EDMONTON—The council has applied to the Dominion Government for power rights at Grand Rapids on the Athabasca River.

STRATHCONA—The city have awarded contracts for 600 k.w. generator to Chapman & Walker, Toronto, $10,160.00; Burnham regulator, Gorman Clancey & Grindley, Edmonton, $750.00; generator engine, Goldie & McCulloch, Galt, $12,000.00; 2,500 hp. boilers, Goldie & McCulloch, $12,750.00; smoke stacks, fans, etc., Canada Foundry Co., Toronto, $7,304.00; 2 feed pumps, etc., Canada Foundry Co., $1,-167.00. The machinery will double the present electrical generating capacity of the city power plant.

SASKATCHEWAN.

YORKTON—A Mirrlees Diesel crude oil engine has been installed in the municipal lighting station. It is a three-cylinder 150 h.p. engine, direct-connected to a Siemens Bros. 3-phase, 60 cycle, 2,200 volt, 257 r.p.m., 80 kv.a., revolving field type alternator.

REGINA—The Jens Orten-Boving Co., Toronto, have received the contract from the city of Regina for one-1,500 k.w. Williams' steam turbine; one 1,500 k.w. Siemens alternator with direct connected exciter; one Mirrlees Watson Co., condensing plant consisting of 4,400 square feet of cooling surface, twin Edwards' air pump, 16 inches diameter by 10 inches stroke, hotwell pump 4½ inches diameter by 6 inches stroke; these latter being driven by an enclosed forced lubrication vertical engine. The condenser and pump capacity is 3,300 gallons per minute at 80 degrees Fah., and 28 inches vacuum with a 30-inch barometer. The amount of the con[illegible] was $7,750.

ONTARIO.

RENFREW—The council have decided to proceed with the construction of the municipal power plant from plans prepared by J. B. McRae, C.E., Ottawa. Estimated cost, $[illegible].

TORONTO—The General Supply Co., with head office in Ottawa, have opened a warehouse and offices at 115-125 Adelaide St., west, where they have 9,000 sq. ft. of floor space. They will handle a full line of mill, machine shop and contractors' supplies. C. R. Medland, formerly with H. W. Petrie, Limited, is in charge of the Toronto branch.

RIDGETOWN—It is proposed to put in a [illegible] $20,000.

SANDWICH—The Canadian Salt Co. are equipping their plant with a 30-ton refrigerating machine, being furnished by The Cleveland Ice Machine Co., Cleveland, O.

WATERLOO—The Kuntz Brewery, will improve their plant by adding a 65-ton York compression side, contract for which was let to the Kent Co., Montreal.

[illegible] a municipal water works on the Welland Canal having secured [illegible] from the Department of [illegible] and Canals, Ottawa.

WINDSOR—The Canadian Automatic Heating & Refrigerating Co. has obtained a [illegible] $150,000.

[illegible] Electric has received a charter with capital of $150,000. [illegible] shareholders'

meeting of the Canadian Westinghouse Company was held at the head office here on March 28. The statements show an increase in net results over the previous year of forty per cent. The net profits for 1910 amounted to $697,393. The management stated that it was probable that increased manufacturing facilities would be required in addition to the extensive additions being made now. The company now has a reserve of $1,176,000, and paid out in wages in Hamilton last year $1,-030,000. The following officers were elected: George Westinghouse, president; R. H. Westinghouse and L. A. Osborne, vice-presidents; P. J. Myler, vice-president and treasurer; S. A. Merrick, general manager; N. S. Braden, manager of sales; John H. Kerr, secretary.

PORCUPINE—Work is being continued on the power plant at Sandy Falls on the Mattagami River. The dam is 730 ft. long and allows 25 ft. head.

COBALT—A new power company, the Northern Ontario Light & Power Co., has been incorporated, with a capital of $7,500,000. It is understood that this company is to take over the power and light systems supplying Cobalt and Haileybury.

PORT ARTHUR—The Hydro-Electric Commission will duplicate the power station here. The contract has been let to Siemens Bros. for $11,200.

QUEBEC.

MONTREAL—E. E. Wallace, dealer in butter and produce, is fitting up cold storage rooms and will install an 8-ton "York" refrigerating machine, contract for which was let to the Kent Co.

MONTREAL—The Congregation de Notre Dame will install an 8-ton "York" refrigerating machine furnished by the Kent Co.

MONTREAL—The plans for Montreal's new filtration plant to cost approximately $2,000,-000 are ready. Tenders will be opened on May 15 for pumping machines, rotary blowers, cranes, low-lift pumps, and other apparatus for construction and maintenance of the filtration plant. It is expected that the plant will be in condition to permit tests during September or October, 1913.

SHERBROOKE—The Canadian Westinghouse Hamilton has been awarded the contract for the generators, switchboards, exciters, etc., costing $40,000, for the municipal power plant.

MONTREAL—The Canadian Light & Power interests which are identified with D. Lorne McGibbon, are negotiating for power rights at Cedar Rapids where they intend erecting a large power plant.

MAGOG—A city power plant will be erected on the Magog River at a cost of about $125,000.

SHERBROOKE—The contracts for machinery to be installed on the Magog river municipal power plant have been awarded to the Canadian Westinghouse Co. and the Jenckes Machine Co.

QUEBEC—The Development Co., of Canada, has been incorporated by R. H. Weldon, Chas. W. Baths and W. B. Smith. They will develop power at Rapids des Quinze and supply power to Cobalt.

NEW BRUNSWICK.

FREDERICTON—H. A. Connell and Geo. McPhail, Woodstock, and John G. Murchie, George A. Murchie and Geo. A. Andrews, St. Stephens, are applying to the legislature for an Act to incorporate the Eel River Light, Heat & Power Co. Capital stock $300,000. They are asking for power to develop the water power on the Eel river and to build transmission lines to Fredericton, Woodstock, St. Stephen, St. Andrews and McAdam.

EDMUNSTON—The council has applied to the legislature for permission to instal a municipal power plant.

Annual Report Canadian General Electric Co.

The annual meeting of the Canadian General Electric Co. and the subsidiary companies, the Canada Foundry Co. and Industrial Realty Co. The Peterboro' plant has been extended, making the machine shop 1,000 ft. in length. The plant of the Canadian Shipbuilding Co., Bridgeburg, has been purchased for structural steel work. The business was reported as satisfactory during the year and the profits 50 per cent. in advance of the year previous. The total orders were reported as nearly $7,000,000.

CATALOGUES.

ELECTRICAL SPECIALTIES—Verity's, Ltd., Birmingham, Eng., for whom the Central Electric & School Supply Co., 36 Adelaide St. West., Toronto, are Canadian Agents, have issued literature on "Z" tungsten lamps, electric fans, etc.

DODGE FRICTION CLUTCH MECHANISM—An interesting and instructive catalogue published by the Dodge Mfg. Co., Toronto, dealing with their clutch mechanism, showing why every manufacturer should give the question of clutches and transmission apparatus generally their careful consideration. All readers should have a copy of this catalogue. A full price list is included.

AIR COMPRESSORS—Bulletin K-89 from the Canadian Rand Co., Commercial Union Bldg., Montreal, describes the "RP" and "RE" duplex power driven air compressors, explaining fully the features of them.

AIR COMPRESSOR—Folder from the Canadian Rand Co., Montreal, describes the Rand Class "RP-2" duplex belt driven air compressor.

TACHOMETERS—Catalogue No. 40, (36 pages) devoted to the complete line of Dr. Horn Tachometers and Tachographs, is issued by The Industrial Instrument Co., Foxboro, Mass., U.S.A. All speed measuring instruments are listed from simple speed indicator to count revolutions, to the elaborate precision variation recorder.

THE RICHARDSON MODEL M MECHANICAL LUBRICATOR is the title of an attractive 16-page catalogue recently issued by the Richardson-Phenix Co., of Milwaukee. Besides giving a description of the Richardson Lubricator, the pamphlet also contains an engineering discussion on the principles of cylinder lubrication. It also contains records of tests and oil consumptions with different kinds of force-feed lubricators, made in several large plants. A unique feature of this pamphlet is a full page photograph showing the sky line of New York, with arrows pointing to all of the buildings containing Richardson Lubricators. It is claimed that 85% of the isolated plants in New York City are equipped with appliances furnished by the Richardson-Phenix Co. Copies of the above pamphlet can be had by addressing the works at Milwaukee, Wis.

TREATMENT OF BOILER FEED WATERS—is the subject of a booklet issued by the Dearborn Drug & Chemical Works, Chicago. It treats the subject fully and will be sent on application.

YORKSHIRE BOILER Catalogue of the Yorkshire Boiler Co., Standard Bldgs., City Square, Leeds, Eng., 30 pages, 5x7 ins., describes the Yorkshire Boiler (with tests) and other specialties, including Feed Water Circulator, full combustion indicator, smoke preventer, automatic damper regulator, pyrometers, fans, etc.

BOILERS—January, 1911, list from R. Jenkins & Co., Rotherham, Eng., of riveted or welded steel sectional boilers. Full dimensions with prices are given and also a number of facts in connection with these boilers.

IMPROVED LUBRICATION—A 12-page catalogue from the "Cromil" Engineering Co., Newcastle-on-Tyne, Eng., describes lubrication using Acheson lubricating graphite.

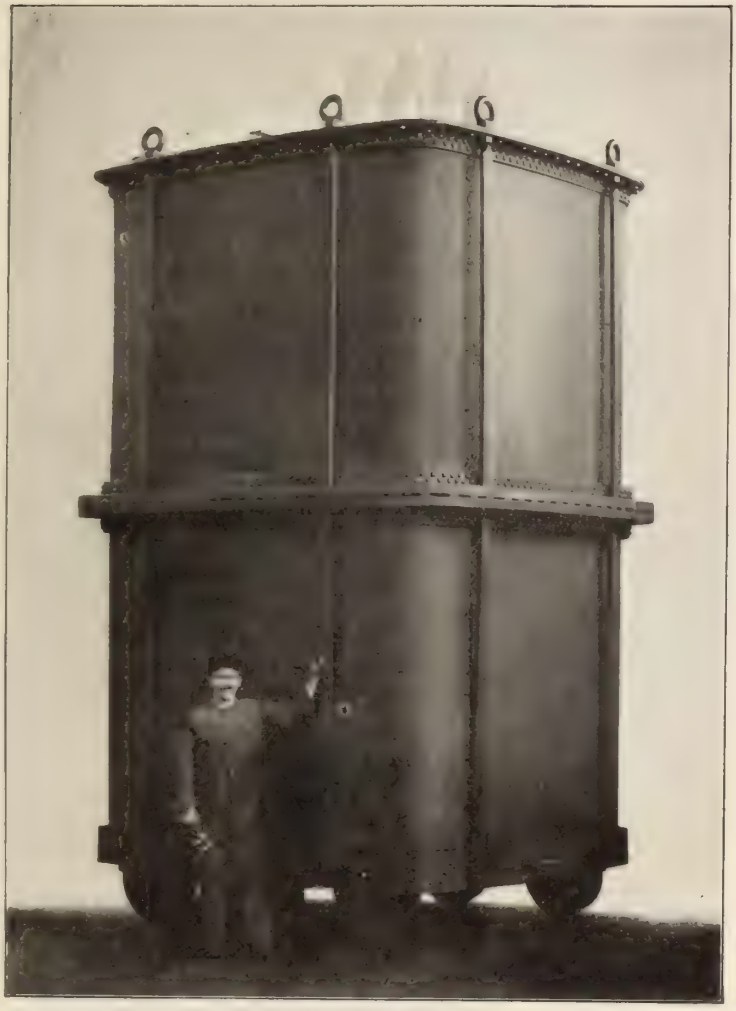
WHITE STAR OIL FILTERS—The Pittsburg Gage & Supply Co., Pittsburg, Pa., have issued a treatise on lubrication, 51 pages, 6x9 ins. on coated paper, White Star Oil Filters and continuous oiling systems are fully illustrated and described.

ELEVATOR CONTROLLERS—The Cutter-Hammer Mfg. Co., Milwaukee, Wis., have issued a 63 page (5x8 ins.) booklet on elevator controllers. It describes and illustrates the electric controllers originally developed by the J. L. Schureman Co., Chicago, but now made by The Cutter-Hammer Mfg. Co.

BELTING—The Federal Engineering & Supplies, Ltd., 284 Yonge Street, Toronto, sole agents for Scandinavia M.C.M. Belting for conveying and transmission have issued a transmission bulletin which describes Scandanavian cotton belting and shows a number of installations.

AIR COMPRESSORS—Bulletin 3007 from The Ingersoll-Rand Co., 11 Broadway, New York, describes fully with detailed illustrations Class "B" Duplex Power Driven Air Compressors.

SIEMENS



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BOOK REVIEWS.

HEAT.—By J. [illegible] Ogden; 128 pages, illustrated; published by the Popular Mechanics Book Department, 225 Washington Street, Chicago; price, 25 cents. This book consists of a series of articles, each complete in itself, yet all pertaining to heat, and its relation to mechanics.

THE TESLA HIGH FREQUENCY COIL.—By [illegible] F. Hailer and Elmer Tiling Cunningham, published by the D. Van Nostrand Co., 23 Murray and 27 Warren Sts., New York, 119 pages, 5½ x 7½ ins., 56 illustrations. Price $1.25 net.

This book on the Tesla coil deals with its construction and uses and is a practical manual on the construction of high-frequency coils which are so useful in scientific investigation. The book describes in detail a 12 in. coil which the authors constructed after carrying on many experiments. It is designed to give a high-frequency discharge a great volume, which fact makes it useful for wireless telegraphy. Chapter X. contains a description of a 7-in. standard coil, and Chapter IX. the uses of it.

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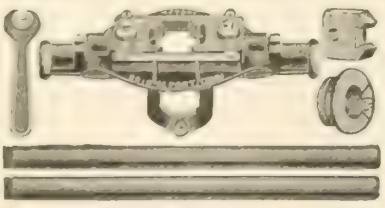
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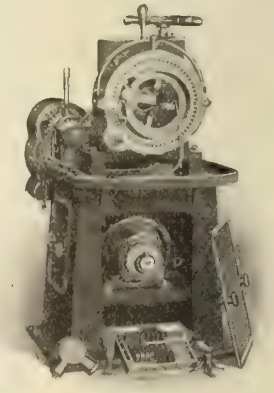
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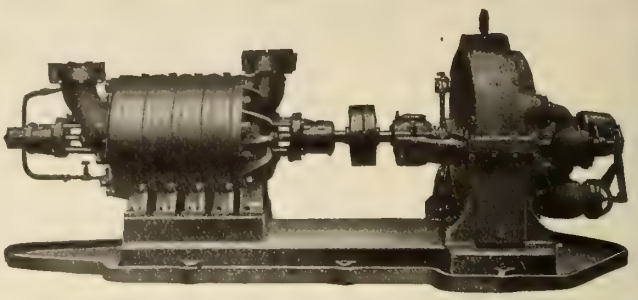

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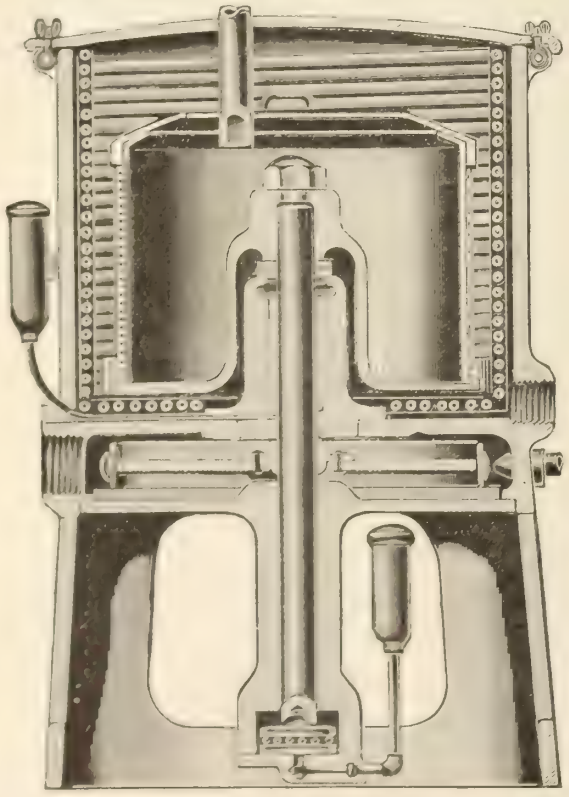

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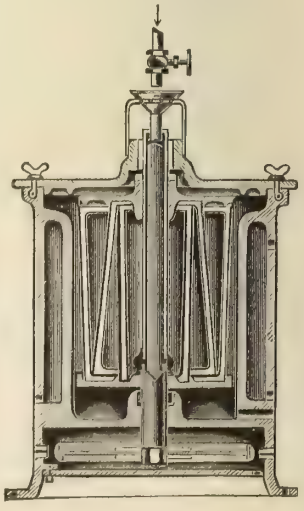

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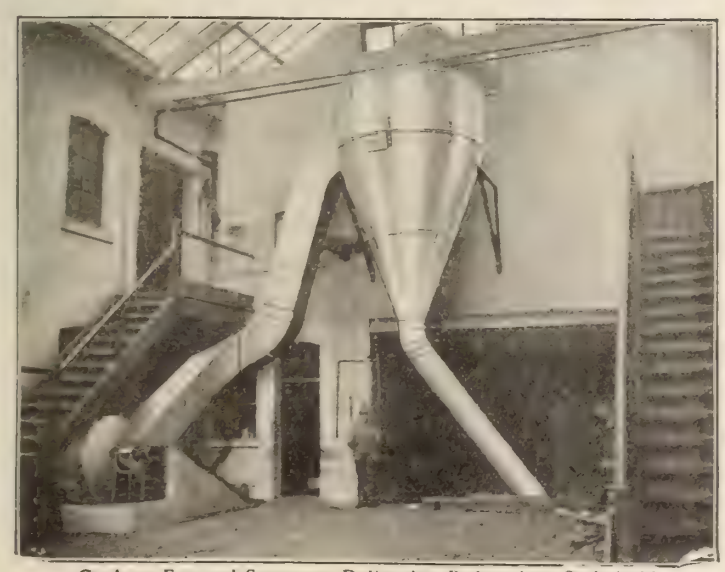

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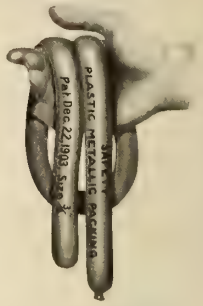

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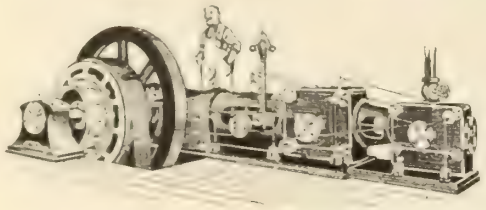

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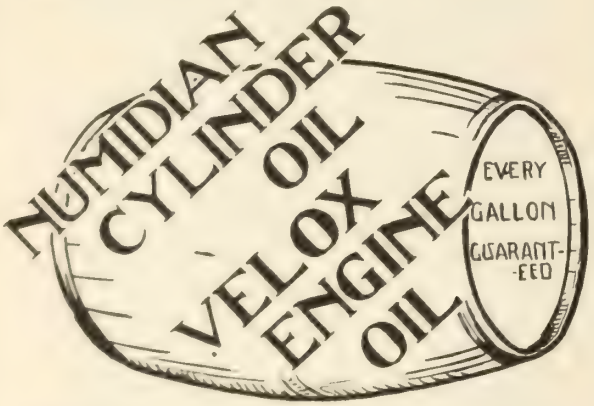

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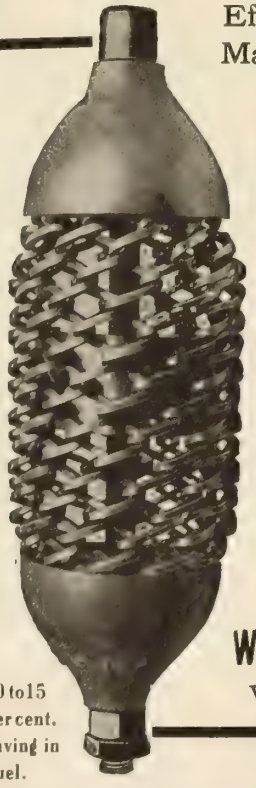

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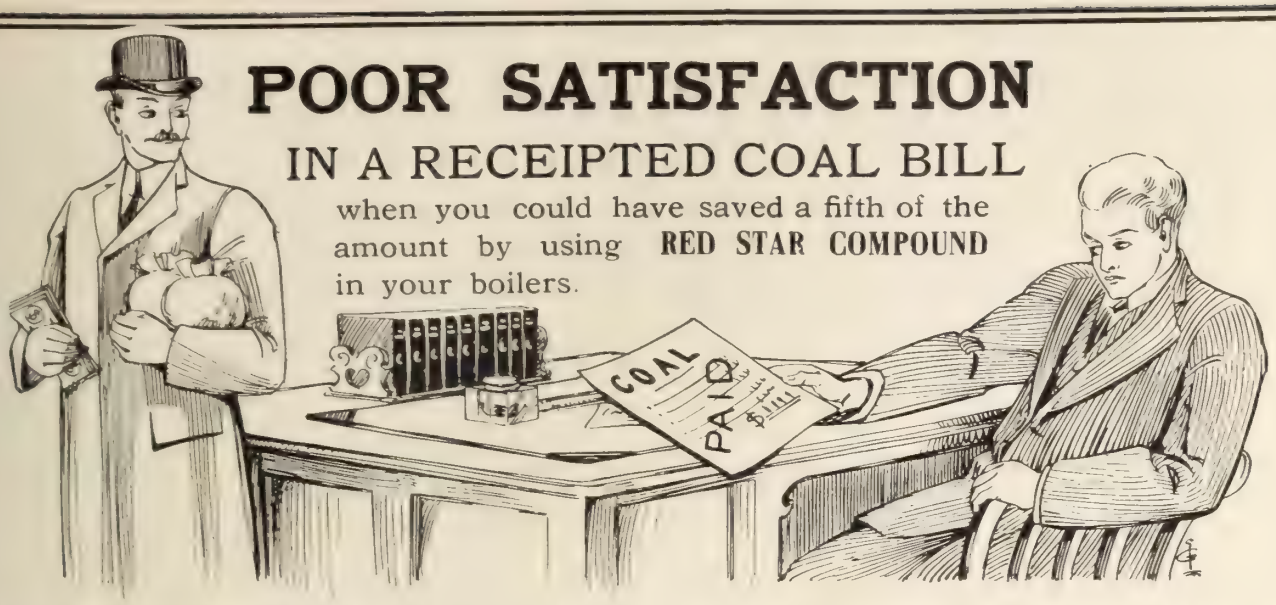

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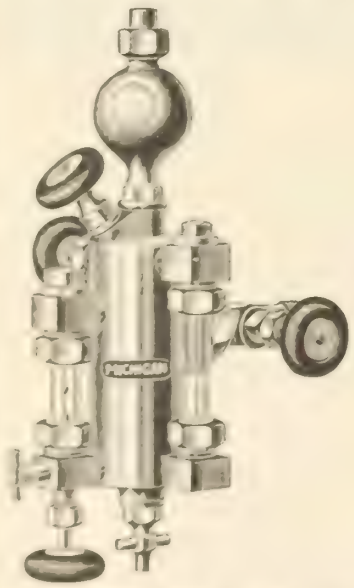

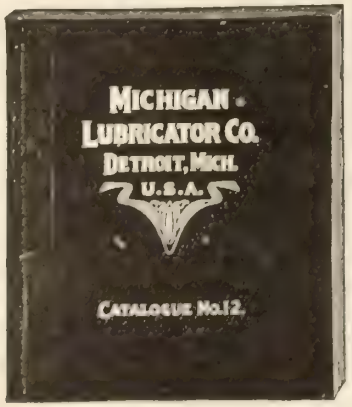

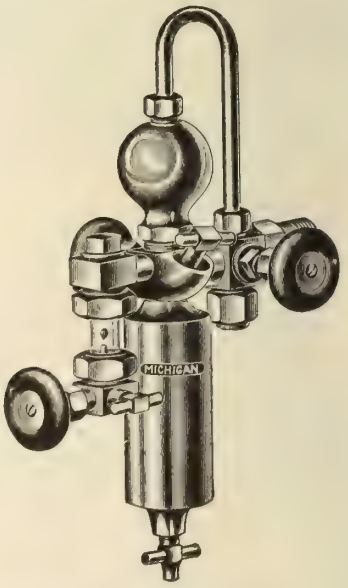

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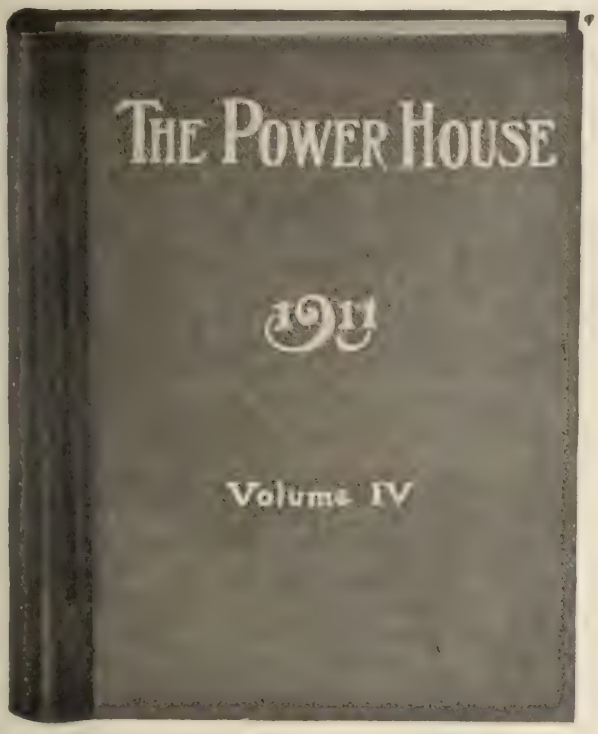

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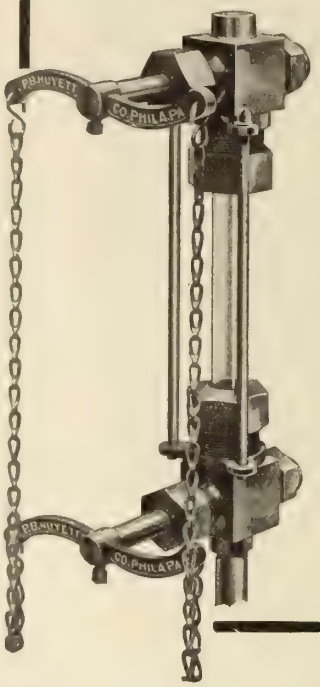

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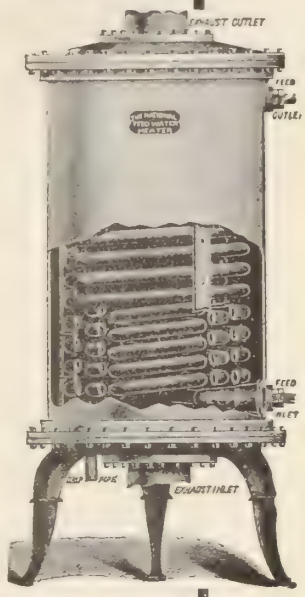

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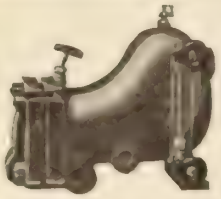

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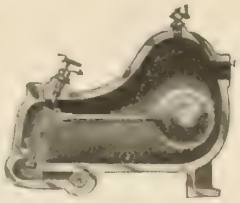

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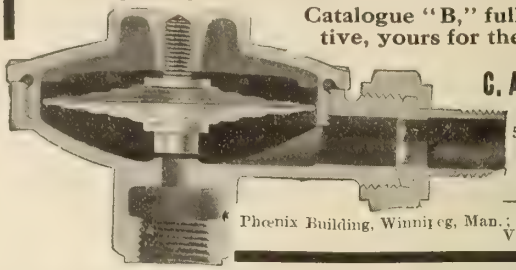

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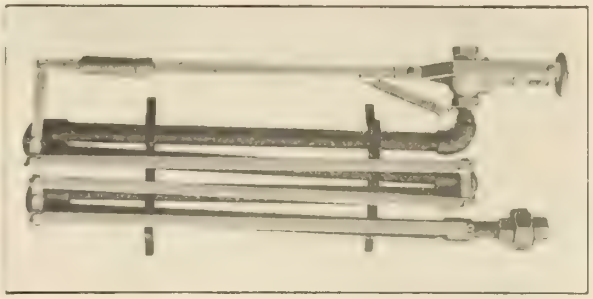

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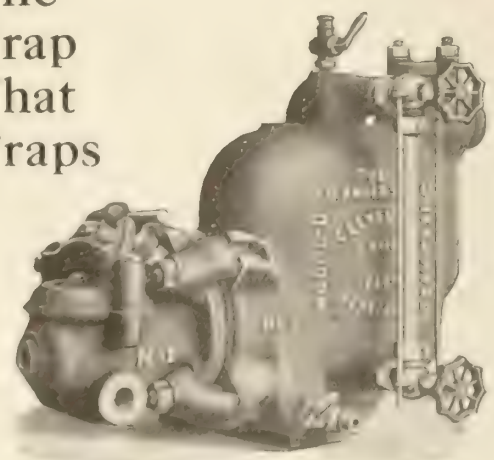

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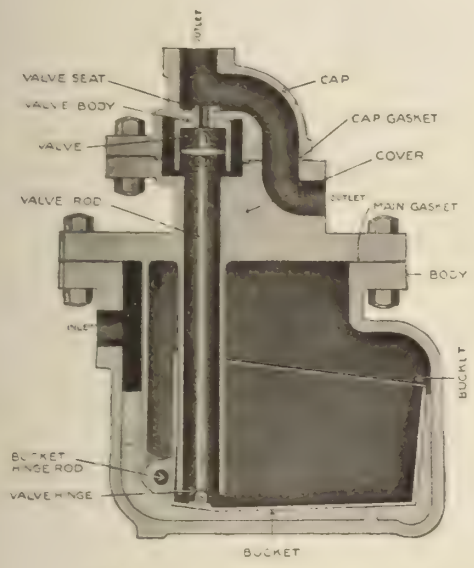

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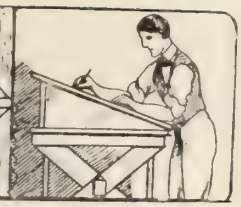

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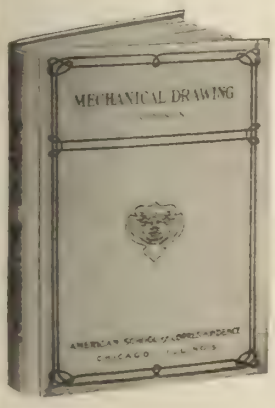

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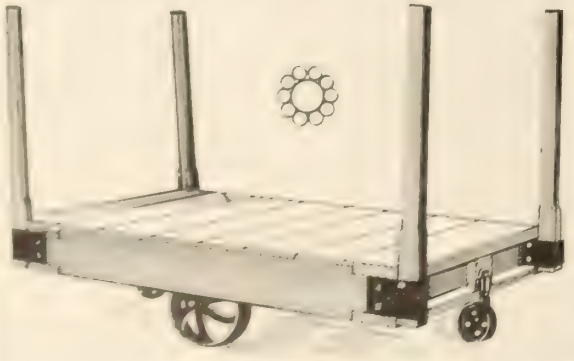

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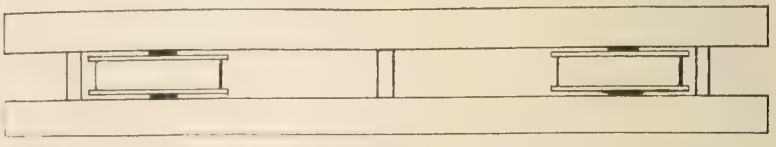

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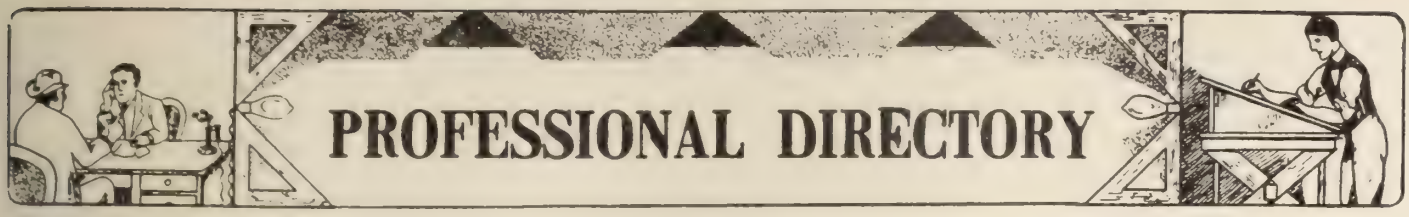

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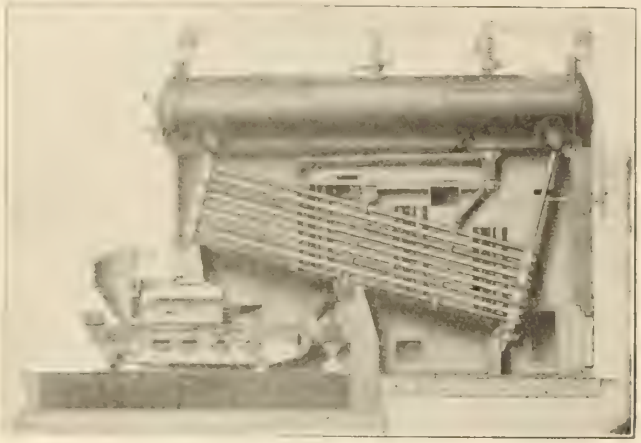

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The Universal Electrical Directory

1911 Edition **Price 14/6**

Divided into four sections, British, Colonial and General, Continental and U.S.A. Any section can at once be referred to by means of a thumb index. Telegraphic addresses, telephone numbers and codes are given in the alphabetical sections, financial particulars of British limited liability companies, also of foreign companies with a British address. The list of electricity undertakings in the United Kingdom, British Colonies and some other countries include the following details: the nature of the supply, system of distribution, capacity of plant, voltage and chief engineer's name, and in the case of alternating current, the phase and periodicity are included. A list of specialities arranged alphabetically according to the name of the articles is given in the British Section.

Publishers: H. Alabaster, Gatehouse & Co.

4 Ludgate Hill, London, England

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The Standard of Quality

Fire Brick for Boiler Settings

Look up, NOT your prices per thousand Brick but your COSTS for repairs per thousand H.P. per hour.

Remember the costly shut downs when every H. P. was needed. It all shows up on the cost sheets.

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Imperial Waste & Metal Co., Montreal
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Belting, Rubber,

Quaker City Rubber Co., Philadelphia, Pa

Belting, Scandinavia and Woven.

Federal Engineering and Supplies, Ltd., Toronto

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Blowers.

Canadian Fairbanks Co., Ltd., Montreal
Eadie-Douglas, Ltd., Montreal
Escher Wyss & Co., Toronto
Eugene F. Gifford, Montreal
Matthews & Yates, Manchester
Power Economies, Ltd., Montreal

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Canadian H. W. Johns-Manville Co., Ltd., Toronto
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Eadie-Douglas, Ltd., Montreal
Hygienic Laboratories, Toronto
C. C. Snowdon, Calgary

Boiler Compound Feeders.

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Hygienic Laboratories, Toronto
Michigan Lubricator Co., Detroit
Morehead Mfg. Co., Detroit, Mich.

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American Steam Pump Co., Battle Creek Mich.
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
C. A. Dunham Co., Ltd., Toronto
Power Economies, Ltd., Montreal

Boiler Feed Regulators.

Canadian Fairbanks Co., Ltd., Montreal
H. L. Peiler & Co., Montreal
Power Economies Ltd., Montreal
Standard Engineering Co., Toronto
Watts Regulator Co., Lawrence, Mass.

Boiler Mountings.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal

Boiler Settings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Boiler Tube Cleaners.

The Paul B. Huyette Co., Philadelphia
Liberty Mfg. Co., Pittsburg
Michigan Lubricator Co., Detroit
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Worcester Brush & Scraper Co., Worcester, Mass.
Vulcan Tube Cleaning Systems, Limited Montreal

Boilers, Horizontal, Tubular and Watertube.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Canada Foundry Co. Ltd., Toronto
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que
Jones Underfeed Stoker Co., Montreal.
E. Leonard & Sons, London, Ont
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.
The Wm. Hamilton Co., Peterborough

Boilers, Marine, Locomotive and Vertical.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Canada Foundry Co., Ltd., Toronto
The Wm Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S
Waterous Engine Works Co., Brantford.

Boosters.

Geo. C. Royce, West Toronto

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Cables, Aerial and Underground.

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Manitoba Bridge & Iron Works Limited, Winnipeg

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Standard Fitting & Valve Co., Limited, Guelph, Ont.

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Lunkenheimer Co., Cincinnati, Ohio
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Cement, Fireproof.

Canadian H. W. Johns-Manville Co., Ltd., Toronto

Cement Machinery.

Canadian Fairbanks Co., Ltd., Montreal

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Dearborn Drug and Chemical Works Chicago
C. C. Snowdon, Calgary

Circuit-Breakers.

Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Clutches.

Elmira Machinery and Transmission Co., Elmira
Manitoba Bridge & Iron Works Limited, Winnipeg
Positive Clutch & Pulley Works, Toronto

Coal and Ash Conveyors.

Babcock & Wilcox, Montreal
H. L. Peiler & Co., Montreal

Coal Handling Machinery

Standard Engineering Co., Toronto

Cold Storage Architects.

E. J. Greenstreet, Toronto

Cold Storage Insulation.

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Canada Foundry Co., Ltd., Toronto
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
H. L. Peiler & Co., Montreal

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E. Leonard & Sons, London, Ont

Consulting Engineers.

Bayfield & Archibald, Vancouver, B.C.
de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
Cleveland & Cameron, Vancouver, B.C.
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Laurie & Lamb, Montreal
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Moore & Scollan, Toronto
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Morris Engineering Co., Vancouver, B.C.
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.
Standard Engineering Co., Toronto

Contractors, Structural Steel

Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto

Conveyor Machinery.

Canadian Fairbanks Co., Ltd., Montreal

Cork Insulation.

Canadian Fairbanks Co., Ltd., Montreal
Linde British Refrigeration Co., Montre

Cotton Hose.

Quaker City Rubber Co., Philadelphia, Pa

Couplings.

Canadian Bond Hanger & Coupling Co., Alexandria Ont.
Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
Elmira Machinery and Transmission Co., Elmira
Manitoba Bridge & Iron Works Limited, Limited

Cranes, Electric.

Babcock & Wilcox, Montreal
Canada Foundry Co., Ltd., Toronto

Crank and Crosshead Pin Oilers.

Corbet Foundry and Machine Co., Ltd., Owen Sound
Michigan Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio

Crushing Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
The Wm. Hamilton Co., Peterborough

Damper Regulators.

Darling Bros., Montreal
C. A. Dunham Co., Ltd., Toronto
Elliott Co., Pittsburgh, Pa.
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Watts Regulator Co., Lawrence, Mass.

Drying Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Dynamos.

Canadian Fairbanks Co., Ltd, Montreal
Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton

Economizers.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal

Electric Fans.

Canadian General Electric Co., Ltd Toronto
Matthews & Yates, Manchester

Electrical Accessories and Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto
Kilmer, Pullen & Burnham, Ltd., Toronto
Northern Electric & Mfg. Co., Limited, Montreal

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Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Waterous Engine Works Co., Brantford.

Engines, Automatic and Drop Valve.

Douglas & Grant, Kirkaldy, Scotland
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E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.

Engines, Corliss and Rocking Valve.

Douglas & Grant, Kirkcaldy, Scotland
Goldie & McCulloch, Co., Galt.

Jenckes Machine Co., Sherbrooke, Que
Robb Engineering Co., Amherst, N.S.

Engines, Gas and Gasoline.

Canada Foundry Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
E. Leonard & Sons, London, Ont

Engines, Hauling and Winding.

Engines, High Speed, Steam.

Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Marine

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont

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Goldie & McCulloch Co., Galt
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

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Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont
Kerr Engine Co., Walkerville
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Vertical.

The John Inglis Co., Ltd., Toronto
International Harvester Co. of America
E. Leonard & Sons, London, Ont
Robb Engineering Co., Amherst, N.S.

Engine Stops.

Strong, Carlisle & Hammond Co., Cleveland
Power Economies, Ltd., Montreal

Exhaust Fans.

Percival F. Gifford, Montreal
Matthews & Yates, Manchester
Power Economies, Ltd., Montreal

Exhaust Heads.

Darling Bros., Montreal
C. A. Dunham Co., Ltd., Toronto
Eadie-Douglas, Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
Watson & McDaniel Co., Philadelphia

Feed Water Alarms.

H. L. Peiler & Co., Montreal

Feed Water Analyser.

Feed Water Heaters

Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
Canadian Steam Boiler Equipment Co., Toronto
C. A. Dunham Co., Ltd., Toronto
Elliott Co., Pittsburgh, Pa.
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
National Pipe Bending Co., New Haven, Conn.
H. L. Peiler & Co., Montreal
Robb Engineering Co., Amherst, N.S.
The Stewart Heater Co., Buffalo, N.Y.

Feed Water Regulators

Canada Foundry Co., Ltd., Toronto
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Watts Regulator Co., Lawrence, Mass.

Filters, Pressure

Feed Water Filters.

James Reggs & Co., New York
Eadie-Douglas, Ltd., Montreal
Power Economies, Ltd., Montreal

Fine Wire Brushes.

Worcester Brush & Scraper Co., Worcester, Mass.

Fire Hose.

Quaker City Rubber Co., Philadelphia, Pa

Fire Brick.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Flanges

Dart Union Co., Toronto

Flue Brushes.

Worcester Brush & Scraper Co., Worcester, Mass.

Flumes, Steel.

Canada Foundry Co., Ltd., Toronto
Corbet Foundry and Machine Co., Ltd., Owen Sound
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont.

Furnace Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Fuses.

Canadian H. W. Johns-Manville Co., Ltd., Toronto
Canadian General Electric Co., Limited, Toronto
Geo. C. Royce, West Toronto

Gaskets, Asbestos and Copper.

American Goetze-Gasket & Packing Co
New Brunswick
Canadian H. W. Johns-Manville Co., Ltd., Toronto

Gas Producer Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Gas Producer Plants.

Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co. Ltd., Toronto
Canadian Westinghouse Co., Hamilton
E. Leonard & Sons, London, Ont

Gauge Cocks.

American Lubricator Co., Detroit
Canadian Fairbanks Co., Ltd., Montreal
Lunkenheimer Co., Cincinnati, Ohio
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal

Gauge Glass Cutters.

Worcester Brush & Scraper Co. Worcester, Mass

Gauge Glasses.

W. J. Wall, Montreal

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Babcock & Wilcox, Montreal
C. A. Dunham Co. Ltd., Toronto
Eadie-Douglas, Ltd., Montreal
Lunkenheimer Co., Cincinnati, Ohio
H. L. Peiler & Co., Montreal

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The Wm. Hamilton Co., Peterborough

Gears, Cut, Worm, Mortise.

Corbet Foundry and Machine Co., Ltd., Owen Sound
The Wm. Hamilton Co., Peterborough

Gears, Spur Level.

Corbet Foundry and Machine Co., Ltd., Owen Sound
Manning, Bourge & Iron Works Limited, Winnipeg

Generators.

Canadian Fairbanks Co., Ltd., Montreal
Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Kilmer, Pullen & Burnham, Ltd., Toronto
Northern Electric & Mfg. Co., Limited, Montreal

Governors.

C. A. Dunham Co., Ltd. Toronto

Graphite.

Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

Grates.

Babcock & Wilcox, Montreal
Canadian Steam Boiler Equipment Co., Toronto
The John Inglis Co., Ltd., Toronto
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal

Gravity Closing Ventilators.

Standard Engineering Co., Toronto.

Grease Cups.

American Lubricator Co., Detroit
Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peterboro Lubricator Co., Peterboro, Ont
Power Economies, Ltd., Montreal

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Canada Foundry Co., Ltd., Toronto
Eadie-Douglas, Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
Power Economies, Ltd., Montreal
C. C. Snowdon, Calgary

Greases

Canadian Fairbanks Co., Ltd., Montreal
Jos. Dixon Crucible Co., Jersey City
Power Economies, Ltd., Montreal
C. C. Snowdon, Calgary

Hangers.

Canadian Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
Elmira Machinery and Transmission Co., Elmira
Goldie & McCulloch Co., Galt.
Positive Clutch & Pulley Works, Toronto
Waterous Engine Works Co., Brantford
The Wm. Hamilton Co., Peterborough

Heating Apparatus.

C. A. Dunham Co., Ltd., Toronto
Matthews & Yates, Manchester

Heaters.

Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
The Stewart Heater Co., Buffalo, N.Y.

Hose Fittings.

Power Economies, Ltd., Montreal

Hose Steam.

Power Economies, Ltd., Montreal

Hydraulic Accumulators.

Canada Foundry Co., Ltd., Toronto
The John Inglis Co., Ltd., Toronto

Hydraulic Machinery.

The John Inglis Co., Ltd., Toronto

Ice Making Machinery.

Linde British Refrigeration Co., Montreal

Index Cocks.

American Lubricator Co., Detroit

Indicators, Electric—All Types.

Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Indicators, Steam Engine.

Canadian Fairbanks Co., Ltd., Montreal
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal

Indicators, Water.

Detroit Lubricator Co., Detroit

Injectors.

Canada Foundry Co., Ltd., Toronto
Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio
Jas. Morrison Brass Mfg. Co., Toronto
Penberthy Injector Co., Windsor.

Iron Filler.

Imperial Waste & Metal Co., Montreal

Lamps, Tungsten, etc

Canadian General Electric Co., Ltd., Toronto
Canadian Tungsten Lamp Co., Limited Hamilton

Lamps, Arc, Incandescent.

Canadian General Electric Co., Ltd., Toronto
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal

Lubricants.

Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

Lubricators, Elevator Guide.

Power Economies, Ltd., Montreal

Lubricators, Force Feed.

Darling Bros., Montreal
Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati
Manzel Bros. Co., Buffalo, N.Y.
Michigan Lubricator Co., Detroit
Power Economies, Ltd., Montreal
Richardson-Phenix Co., Milwaukee, Wis
Twin City Oil Co., Berlin, Ont.

Lubricators, Plain.

Detroit Lubricator Co., Detroit
C. A. Dunham Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio

Lubricators, Steam, Gas Engine.

American Lubricator Co., Detroit

Maple Cogs.

The Wm. Hamilton Co., Peterborough

Mechanical Stokers.

Babcock & Wilcox, Montreal
Standard Engineering Co., Toronto

Meters, Electric

Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto.

Meters, Water

H. L. Peiler & Co., Montreal

Mill and Mining Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd. Owen Sound
Douglas & Grant, Kirkcaldy, Scotland
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Madison Williams Mfg. Co., Lindsay, Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Motors.

Canadian Fairbanks Co., Ltd., Montreal
Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Eadie-Douglas, Ltd., Montreal
Kilmer, Pullen & Burnham, Toronto

Northern Electric & Mfg. Co., Limited, Montreal

Motor Starters and Controllers.

Canadian General Electric Co., Ltd. Toronto
Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Oilers, Gang.

Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis.

Oilers, Multiple.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio

Oil Cups.

American Lubricator Co., Detroit

Oil Filters

Canadian Oil & Waste Saving Machine Co., Ltd., Brockville
Darling Bros., Montreal
Eadie-Douglas, Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
Power Economies, Ltd., Montreal
Richardson-Phenix Co., Milwaukee, Wis

Oil Separators.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
Elliott Co., Pittsburgh, Pa.
C. A. Dunham Co., Ltd., Toronto
Eadie-Douglas, Ltd., Montreal
Liberty Mfg. Co., Pittsburg
Power Economies, Ltd., Montreal
Standard Engineering Co., Toronto

Oils, Lubricating.

Dearborn Drug and Chemical Works, Chicago
C. C. Snowdon, Calgary

Packing Engines.

Federal Engineering and Supplies, Ltd., Toronto
Power Economies, Ltd., Montreal

Packing, Metallic.

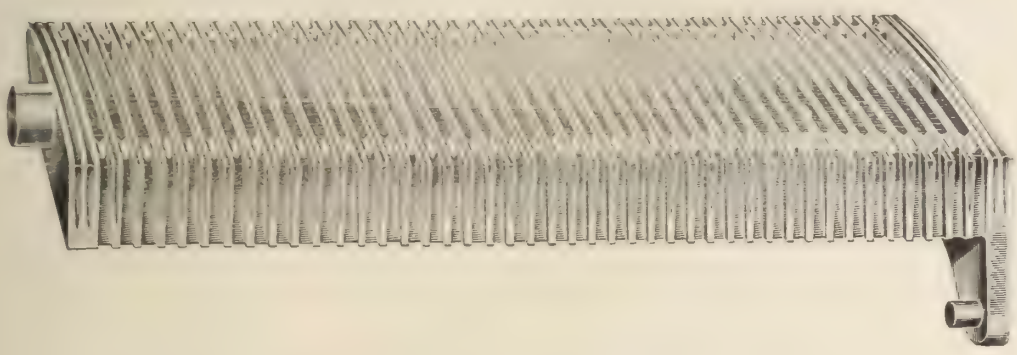
Canadian H. W. Johns-Manville Co., Ltd., Toronto
Garlock Packing Co., Hamilton, Can.

THE

20 Century Shaking and Dumping Grate Bar

DESIGN REGISTERED No. 14

TOP AND SIDE VIEW OF BAR

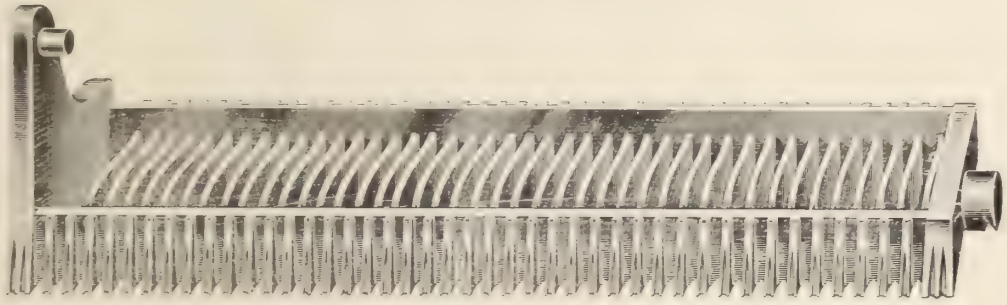


Note the Channel Sections and V surface of Truss.

Leaving practically no dead space, giving almost Complete Combustion by a direct circulation of air from under and over face of bar also increasing life of Bar.

BOTTOM AND SIDE VIEW OF BAR

Note the depth of sections from top to bottom of sections.



This Bar has a greater Dumping Capacity for the removal of Clinkers than any bar in the market

The above cuts fairly represent the Grate and Sections in our Improved Shaking and Dumping Grate Bar. We have after a number of tests succeeded in so improving the grate by increasing the air space and giving depth to the sections or tranverse leaves as to increase life of Bar and give greater efficiency. The length of service a Shaking and Dumping Grate can give, together with its ease of operation and economy of fuel are the most vital points and the points most interesting to Managers and Engineers of all steam using plants.

We have so improved our bar that we claim that it will give better service having greater air space. Easier of operation and burning the lowest grades of fuel with the best results, as in a number of plants where we have installed Grates they are now using Hard and Soft Coal Screenings and Soft Coal Screenings and Coke, one half of each, in which they were formerly burning the best Steam Coal giving better results and doing away with the smoke nuisance. If you are in need of Grate Bars or anticipate making any change in your plant we would ask you to consult us as we are prepared to supply and contract for the following work and Boiler Room Supplies.

20 Century Shaking and Dumping Grate Bar. All kinds of ordinary Grates. Cleaning and Repacking Boilers. Patching and Retubing Boilers. Flue Cleaners. Blowers and Scrapers. Best Makes Boiler Fronts, Dead Plates and Arch Plates

We have been appointed sales agents by H. L. Peiler & Co., Montreal, for his well-known line of steam specialties and have taken over his offices and phone, M 1608.

CORRESPONDENCE SOLICITED

The Boiler Repair and Grate Bar Company

Room 216 ST. JAMES CHAMBERS

69 Adelaide Street East - - - - TORONTO

H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Quaker City Rubber Co., Philadelphia, Pa
Robertson Improved Metallic Packing Co., Ltd., Montreal
Steel Mill Packing Co., Detroit, Mich

Packing, Rod.

[illegible] Hamilton, Can

Packing, Sheet,

[illegible] Co., Hamilton, Can
Canadian H. W. Johns-Manville Co., Ltd., Toronto
[illegible] Philadelphia, Pa

Packing, Ammonia, Steam and Water.

Canadian H. W. Johns-Manville Co., Ltd., Toronto
[illegible]
Power Economies, Ltd., Montreal
Premier Eng. & Mfg. Co., New York
Quaker City Rubber Co., Philadelphia

Penstocks.

[illegible]
Corbet Foundry and Machine Co. Ltd., Owen Sound
The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto

Pipe Coils.

National Pipe Bending Co., New Haven, Conn.

Pipe Cutting and Threading Machines and Tools.

Canadian Fairbanks Co., Ltd., Montreal
Curtis & Curtis Co., Bridgeport, Conn.

Pipe, Steel

Canada Foundry Co., Ltd., Toronto
The John Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont.
The Wm. Hamilton Co., Peterborough

Pipe (Second-Hand.)

Imperial Waste & Metal Co., Montreal

Pipes, Water.

Canada Foundry Co., Ltd., Toronto
Pacific Coast Pipe Co., Vancouver, B.C

Piping, Steam,

Babcock & Wilcox, Montreal
Imperial Waste & Metal Co., Montreal

Planimeters.

H. L. Peiler & Co., Montreal

Plate Work.

Canada Foundry Co., Ltd., Toronto
Corbet Foundry and Machine Co., Ltd., Owen Sound
The John Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt
Jenckes Machine Co., Sherbrooke, Que
Waterous Engine Works Co., Brantford

Polish, Metal.

G. W. Hoffman, Indianapolis

Power Pumps.

American Steam Pump Co., Battle Creek Mich
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
Darling Bros., Montreal
C. A. Dunham Co., Ltd., Toronto
The John Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt
Goulds Pump Co., Montreal.
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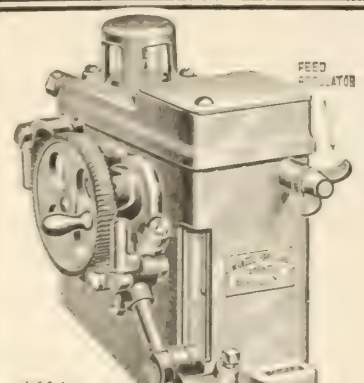

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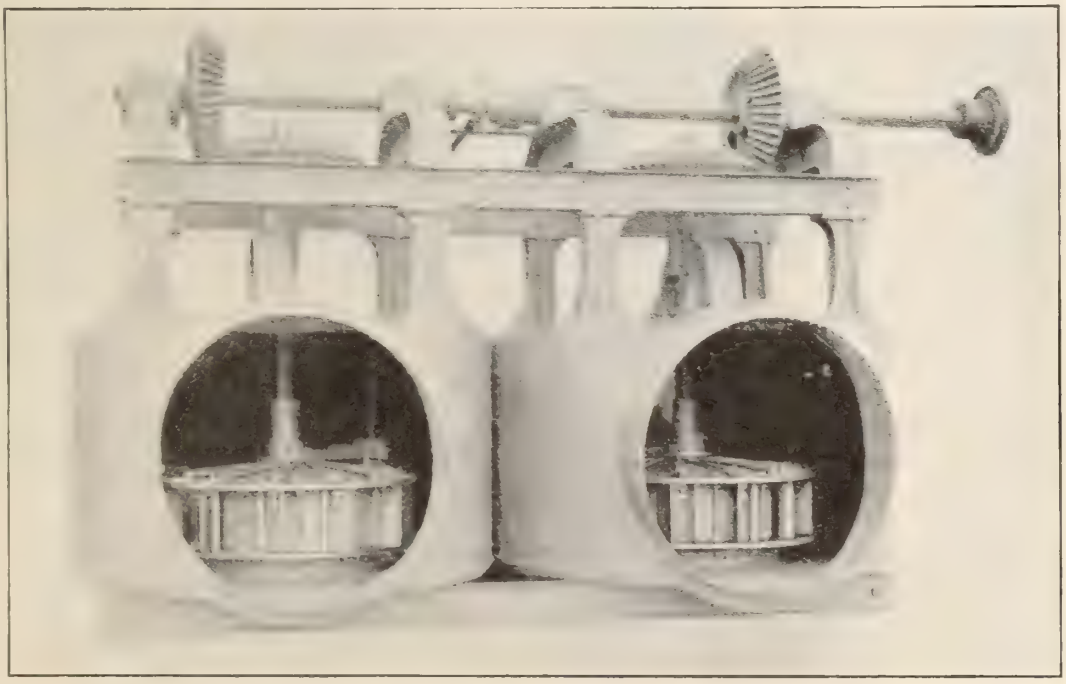

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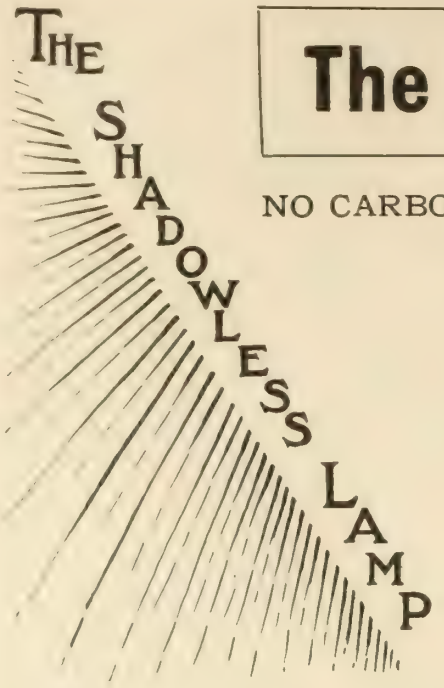

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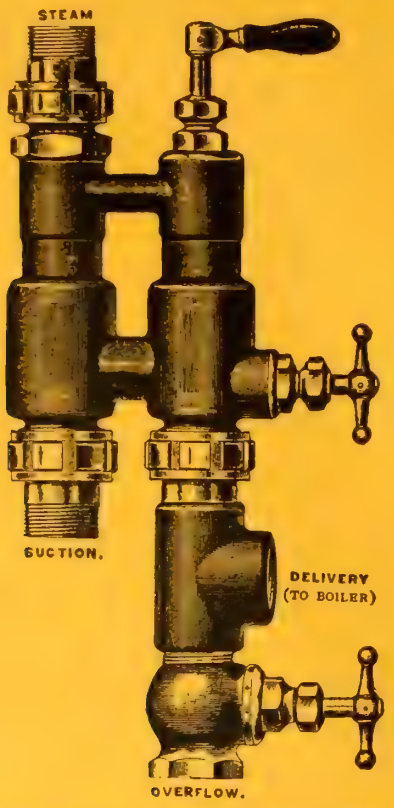

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Water can be elevated above machine about 2½ feet for each pound of steam. With 45 lbs steam pressure, water can be lifted 25 feet and elevated 112 feet above Inspirator, a total of 137 feet.

For the Best "all-round" satisfaction the Hancock is the Machine to use.

Manufactured by

The James Morrison Brass Mfg. Co., Limited

93-97 Adelaide Street West, TORONTO

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THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
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Vol. IV. Publication Office, Toronto—May, 1911 No. 5

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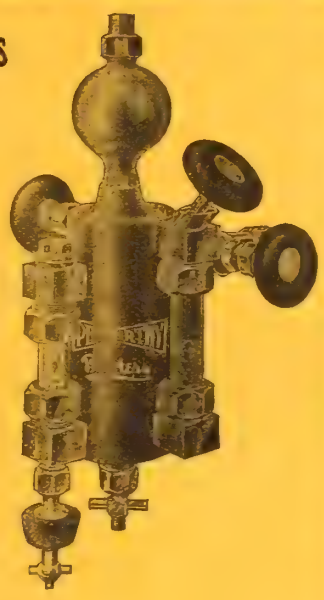

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We Claim
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EVERY ENGINEER
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Manufactured by
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PENBERTHY

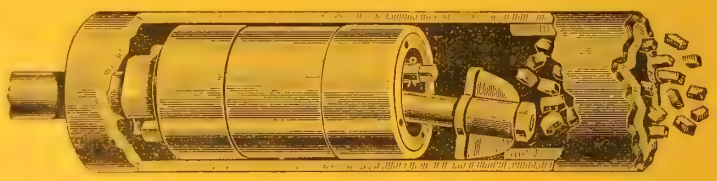
The Dean Boiler Tube Cleaner for the Small Power Plant

There's many a small power plant throwing away opportunities of saving money.

It is human nature to overlook small savings. People would try to economize if they could make a big saving. But when the saving is small they say: "What's the use?"

Take the subject of scale removal, for instance. How many managers or engineers of small power plants take the cost of scale seriously?

"I have only two small boilers. More or less coal—what's the difference? What if the boilers are pushed? I have enough steam to run the plant. No, it wouldn't pay to get a Dean for this plant, no matter how good it may be."



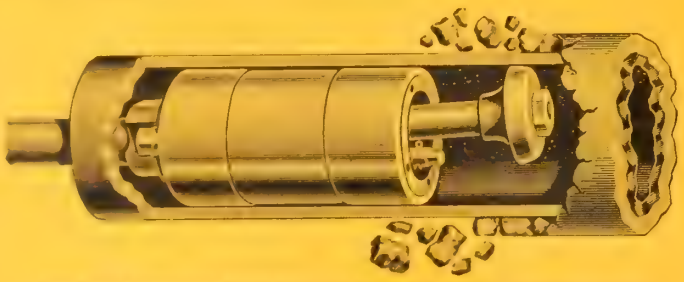
The Dean Removing Scale from the Tube of a Water Tube Boiler

With this excuse many a man brushes aside an opportunity to SAVE the price of the Dean several times over.

Let's get down to brass tacks—

Can the Dean Save Money in a Small Power Plant?

Yes, our records prove this conclusively. We have lots of concerns on our books, operating two small boilers, saving two or three dollars a week on each boiler because they use a Dean to keep their tubes clean.



The Dean Removing Scale from the Tube of a Return Tubular Boiler.

Not a large amount each week, to be sure—but see what it amounts to in a year.

Worth going after, isn't it?

Remember this: We guarantee the Dean to pay for itself in six months' use; otherwise it may be returned at our expense, and we'll refund the purchase price.

But before you even think of purchasing a Dean—try it out and find out exactly what it can accomplish. We'll loan you a Dean for free trial in one of your boilers. Why not write for it now?

Let us send you a copy of our interesting booklet, "Scale Removal Made Easy," anyway.

The Wm. B. Pierce Company

330 Washington Street, Buffalo, N.Y.

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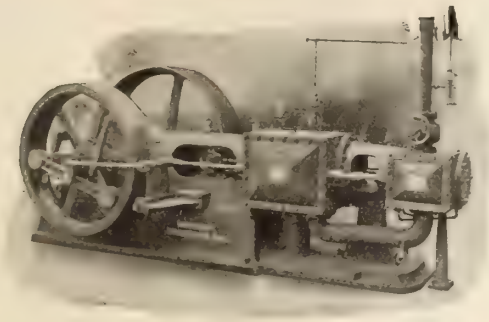
The advertiser would like to know where you saw his advertisement—tell him.



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High Speed Automatic
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Are built essentially for the economical production of electric light and power. Directly connected to dynamo, they cannot be equalled for smoothness of running, absolute reliability and for capacity to absorb overload without flinching.

The special feature of these engines—CLOSE AND INSTANTANEOUS REGULATION—is obtained by the famous Begthrup Inertia governor. This, the first successful shaft governor built, is covered by our rock-bottom guarantee, as follows:—

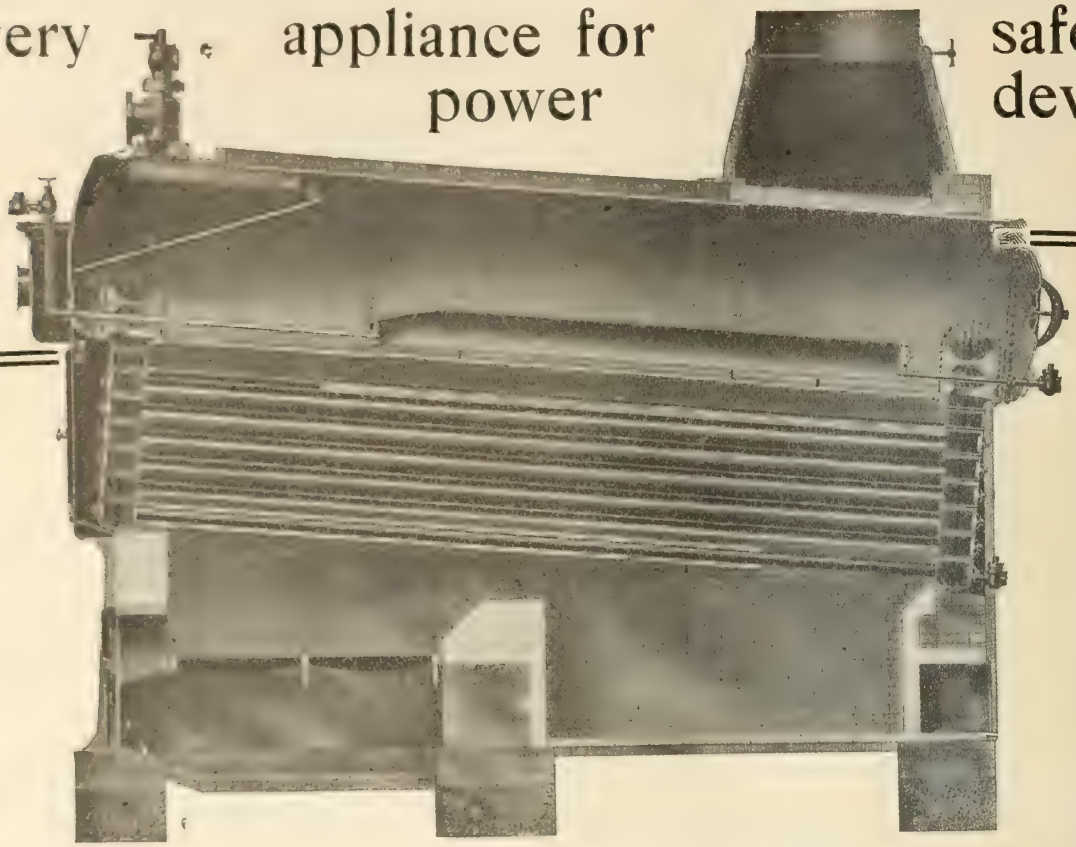
The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution. Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar.

McEwen Engines are built in simple and compound units up to 700 H.P. Every machine tested under full load before leaving the works.

Send for our Engine Booklet.

The Waterous Engine Works Co., Ltd.
BRANTFORD, CANADA

The HEINE SAFETY BOILER has every appliance for safe power development



The Heine Safety Boiler

has proved its worth and has been installed in many of the world's best steam plants. It is a thoroughly modern boiler.

The HEINE type boiler absorbs more heat than others, and transmits it more certainly to the water

The result is a dry steam with a minimum fuel consumption.

HEINE Safety Boilers are economical, lasting well under hard usage, and are equipped with a mud drum that effectively purifies the water, precipitating all scale and filth.

May we send you our descriptive literature of interest to every boiler user?

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For Mining Service, handling any kind of ore, also for crushing Rock for Railroad Ballast, Macadam, Concrete, etc., the Farrel Bacon Crusher is unequalled. We build it in all sizes and have types developed to meet every crushing requirement; also complete crushing plants, including screens, elevators and power equipment.

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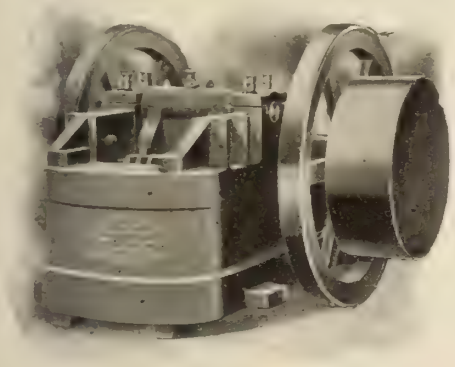
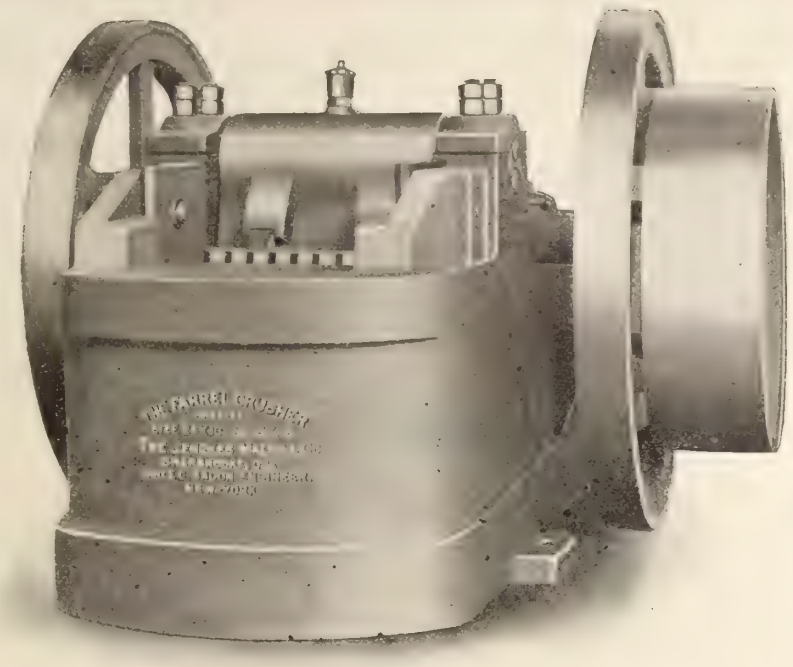
Full particulars gladly sent on request.





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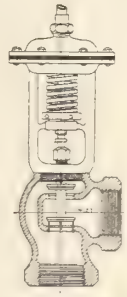

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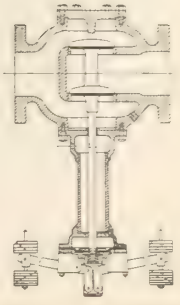

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Power Economies, Limited

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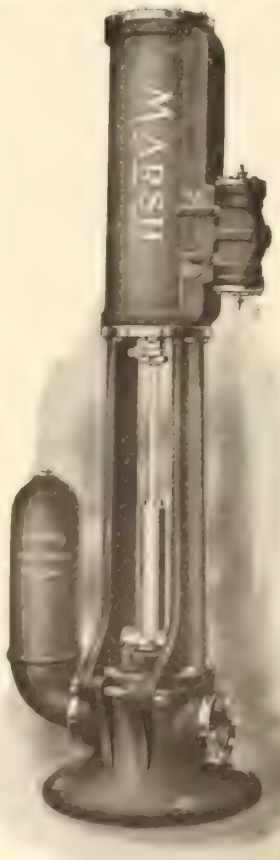

DEEP WELL PUMPING

Are you sure that you are obtaining the maximum capacity from your well with a minimum steam consumption?

The distinguishing feature of Marsh Deep Well Pumps is high efficiency combined with low cost of up-keep. They are equipped with a self-governing steam valve which admits just enough steam to do the required work. They are made with hinge base, affording easy access to the well pipe at all times.

AIR LIFT SYSTEMS

We also manufacture a line of steam and power driven air compressors which combine durability with highest efficiency. The Marsh Steam Valve is especially adapted for air compressor service.

Ask for our No. 18 catalog.

American Steam Pump Co.

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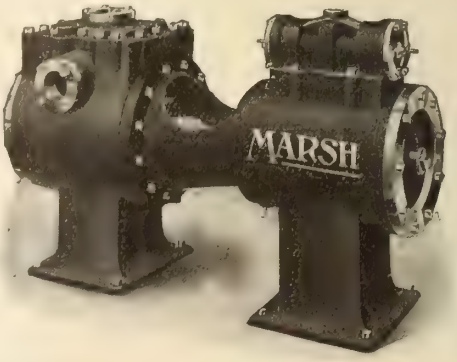

GOETZE'S NO. 2 GASKETS

Are Thick Enough and Thin Enough

For Severest Service in Ranged Pipe Joints.

They're thick enough to make a PERMANENTLY tight joint where several thinner gaskets must be used to make a joint TEMPORARILY tight. They're thick enough to take good care of contraction and expansion. They're thick enough to make a leak-proof joint where the piping is sufficiently "out of line" to make a wide space between the flanges on one side and a narrow space on the other. They're thick enough to be used over and over. And yet they're THIN enough for any flanged pipe joint that needs a gasket.

They're 1-8 Inch Thick, But They "Squeeze" to 1-16 Inch Thick

1/8 inch — 1/16 inch.

if necessary when you use your wrench on the flange bolts.

Goetze's Elastic Corrugated Copper Gaskets with Asbestos Lining No. 2 are thick enough and thin enough to be strong enough and more than "good enough" for the most troublesome flanged pipe joints you ever saw. Those corrugations of copper not only touch the roughest flanges at every point, but flatten enough when the bolts are turned to bring the rings of asbestos tight against both of the flange faces. That gives you alternate walls of copper and asbestos—a number of each—between the inside edge of your piping and the outside edge of your flange. That means TIGHT JOINTS—not for days or weeks, but for YEARS.

Be as skeptical as you like, but don't let it prevent you from accepting our offer to send you

A Supply of Goetze's No. 2 Gaskets on 90 Days' Trial at Our Risk

for that's the way we PROVE our claims and show you that Goetze's No. 2 Gaskets can and will save you a lot of time and money. It would be a good idea to try, at the same time and on the same condition, a few of Goetze's Copper Valve Gaskets. They're made for valves of McAvity's Victor and Jenkins type and they do the business. Give size or sizes wanted, and say whether with round hole or hole with two flat sides.

Goetze's Gaskets are carried in stock by T. McAVITY & SONS, Limited, St. John, N.B.

Branches at MONTREAL 163 Esplanade Ave. — TORONTO 404 McKinnon Bldg. — WINNIPEG Box 331 — VANCOUVER care A. O. Campbell.

Ask for Catalogue of Packings for all Power Plant Purposes.

American Goetze-Gasket & Packing Co., New Brunswick, N.J.

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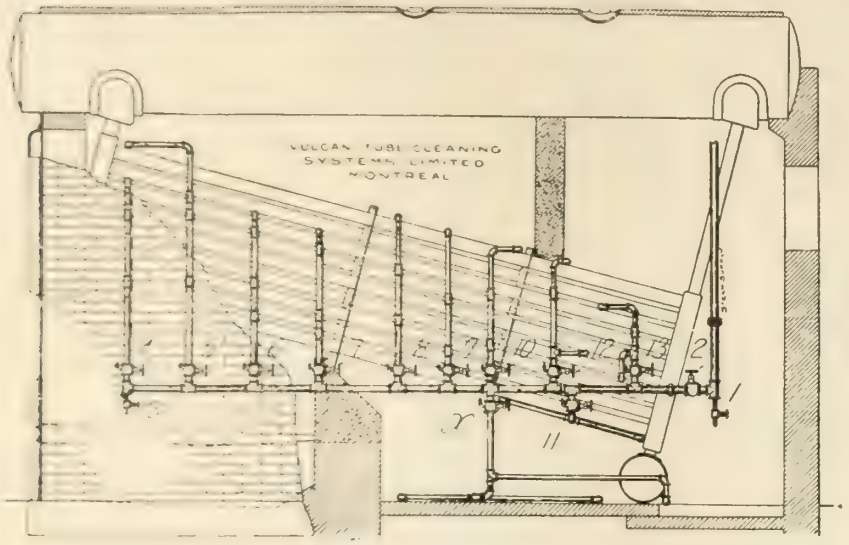
First Aid to the Soot-Sick Boiler— The Vulcan Soot Cleaner



The Vulcan Installed on a Water Tube Boiler.

The Vulcan for Fire Tube and Water Tube Boilers.

Manufactured under Patents Nos. 89841 and 95665.

A movable blow-pipe with a number of nozzles so placed that no tube will escape thorough cleaning.

Pipe swings in a half circle across the entire tube area and discharges jets of dry steam directly into every tube—always blowing with the draft.

It is operated by means of a handle and a swivel on the outside, snd when not in use the blow-pipe is drawn into a recess in the rear wall away from the heat.

The steam enters the tubes with full force.

For Water Tube Boilers THE VULCAN SYSTEM consists of an arrangement of piping which cleans every square inch of the boiler's heating surface. Send for detailed description.

These cleaners will be installed or sent to any responsible firm on 30 days' trial. They are guaranteed to accomplish satisfactory results; are guaranteed against defects in workmanship or material for one year; they are further guaranteed to save their cost in six months or less

THE importance of soot removal needs no explanation. You know that soot prevents absorption of the heat supplied by the coal, permitting valuable heat units that should reach the feed water to escape up the stack.

You know that a small boiler with clean tubes is equal in steaming ability to a large boiler with tubes choked up with coal-wasting soot.

And knowing this you try to blow out the soot with some boiler straining, man-killing front-end hand-blower which, blowing against the draft, can never accomplish thorough cleaning—

Despite the trouble it causes, the shut downs, the night work, etc.

Put aside the old-fashioned inferior cleaning device.

Put in the modern system of soot cleaning, the Vulcan System.

Put it in at our expense. Try it 30 days Free.

You'll be surprised at the results; the ease with which it cleans; the thoroughness.

The fireman or engineer, instead of shirking the job, will do it gladly.

The whole operation of cleaning the entire boiler takes two minutes; the operation consists of turning a valve to let in steam.

This trial costs you nothing, puts you under no obligation.

On the other hand we positively guarantee the Vulcan to pay for itself in coal saving inside of six months.

So this trial gives you the chance to save 1-6 the cost of your Vulcan before you pay us a cent.

Certainly a proposition that it will pay you to accept whether yours is a small plant or a large.

The sooner you get it started in your plant the sooner will you save on your coal and repair bills, the sooner will you get 100% value from your boiler.

Why not act NOW?

The Vulcan for Fire Tube Boilers is Another Marvel of Efficiency

Our Free Booklet

"Economical Steam Production" goes into complete details about Soot Removal; shows why soot is costly, why it should be removed completely; and shows how the Vulcan accomplishes this result. Shows the Vulcan installed in various types of boilers, and explains our guarantee and Trial offer. Send for your copy to-day.

Mail Coupon to Montreal Office ☛

Vulcan Tube Cleaning Systems
LIMITED

Factory and Home Office:

4 Bonsecours Street - MONTREAL, Que.

Western Agents, J. L. NEILSON & CO., 602 Main St., Winnipeg

Power House, 5-11 Date.....

Vulcan Tube Cleaning Systems, Limited,
4 Bonsecours Street, Montreal, Que.

Please send us, without charge, your book---ECONOMICAL STEAM PRODUCTION, and your proposition.

WATER TUBE BOILERS

No. of Boilers..... Type..... Pressure.....

Horse Power.....No. Tubes High (except on Stirling boiler).....

Any Superheaters?..... Width of alley space at side.....

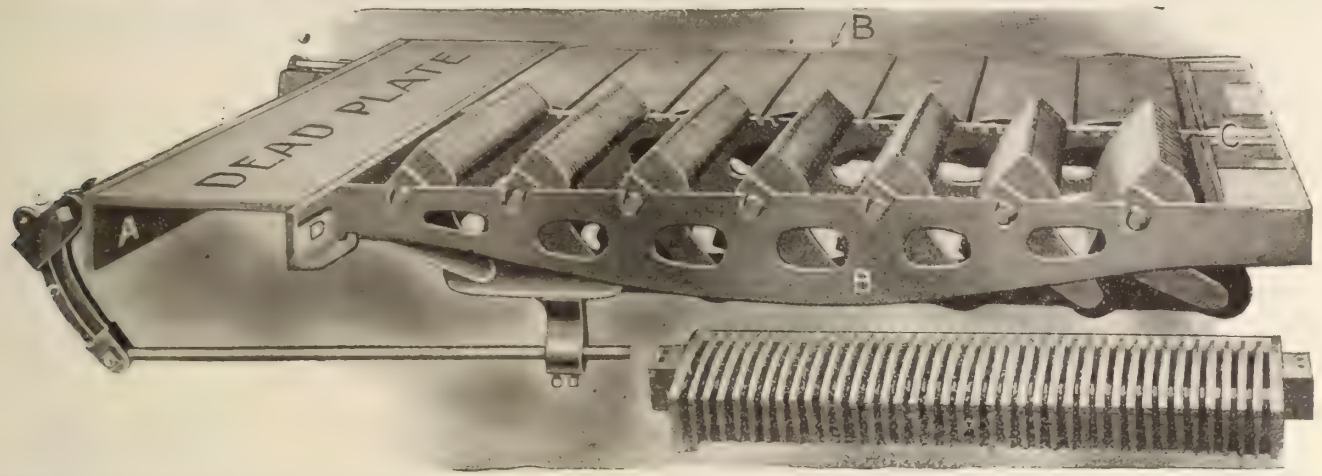
TUBULAR BOILERS

No of Boilers..... Horizontal or Vertical.....

Note---It is important that the above information be given in full.

Name.....

Address.....



Grates That Save in Fuel

IT is dangerous to burn low-grade fuel on the ordinary grate. The intense heat it generates will warp them, and the first thing you know they refuse to shake, get clogged with clinkers, and burn out. Consequence---the replacing of your entire grate, a constantly recurring expense.

CYCLONE GRATES are made up of heavy bars that never get hot enough to warp. The expansion is taken up by a unique arrangement, and the bars rest on a wedge edge so that there is no friction.

Free air circulation is assured by the shape of the bars, giving 68 per cent. of air space and 90 per cent. of under draught.

In every way the "***CYCLONE***" has the ordinary grate beaten.

Ask those who use them.

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"THE Cyclone"

Shaking and Dumping Grate Bar

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Limited

SOLE MANUFACTURERS FOR CANADA

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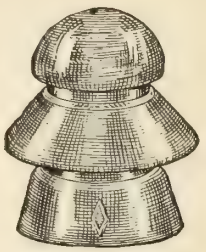

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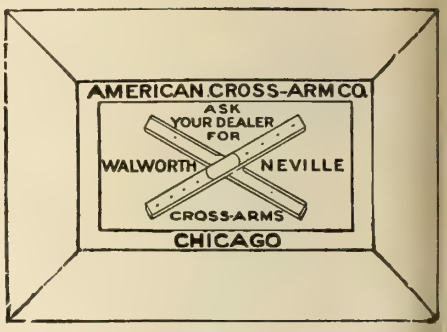

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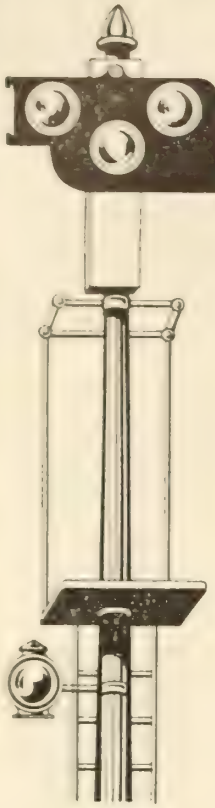

WATCH YOUR BOILERS!

TROUBLE AHEAD

Unless You Guard Against Scale.

Scale-forming substances and elements are almost always present in the water you feed into your boilers.

The signs of scale formation are a decrease in the steam-making power, and an increase in your coal consumption—signs of harm already done, danger of burned-out tubes, and in time the entire replacing of your boilers.

GUARD YOURSELF by using

The Dearborn Treatment

Forward a gallon of the water you are using, and we will prescribe for your boilers. No charge made for analysis. We give absolute satisfaction.

Dearborn Drug and Chemical Co.

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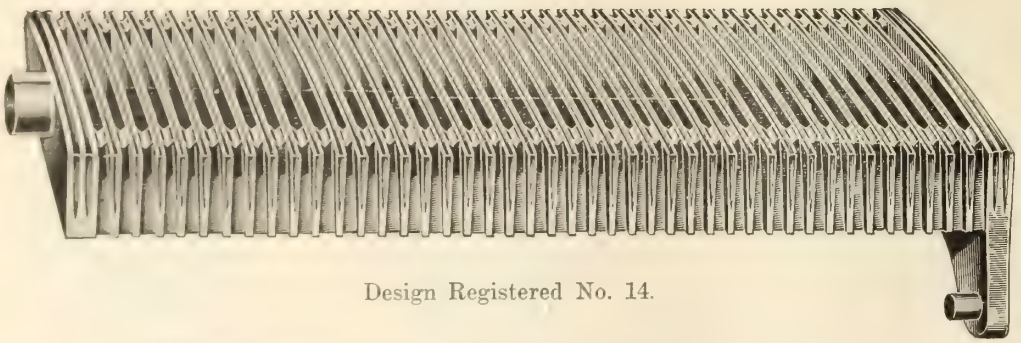
CHICAGO

Eastern Offices
299 Broadway, ***NEW YORK***

The 20 Century Shaking and Dumping Grate Bar

TOP AND SIDE VIEW OF BAR



Note the Channelled Sections and V-shape of Truss.

Design Registered No. 14.

This Bar has a greater Dumping Capacity for the removal of Clinkers than any bar on the market.

The above cut fairly represents our Improved Shaking and Dumping Grate Bar. We have after a number of tests succeeded in so improving the grate by increasing the air space and giving depth to the sections or transverse leaves as to increase life of Bar and give greater efficiency. The length of service a Shaking and Dumping grate can give, together with its ease of operation and economy of fuel, are the most vital points and the points most interesting to Managers and Engineers of all steam-using plants.

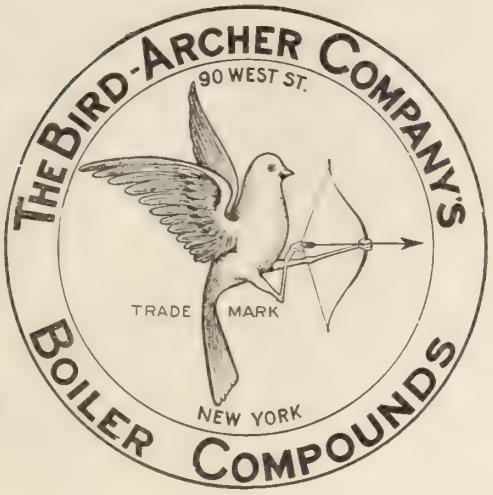
We have been appointed Selling Agents for the well-known line of Steam Specialties of H. L. PEILER & CO., Montreal, BUNDY'S TRAPS, ASHTON'S RELIEF VALVES, PRESSURE AND VACUUM GAUGES, BERRY FEED WATER CONTROL AND STEAM SPECIALTIES, FRANCE METALLIC AND FIBROUS PACKING. We can supply the Boiler Room with Steam Specialties of all kinds of the very best makes at lowest prices.

CORRESPONDENCE SOLICITED

The Boiler Repair and Grate Bar Company

Manufacturers 20 Century Grate Bars. Boiler Repairs. Work of all kinds promptly attended to.

Office: 215-217 St. James Chambers, 69 Adelaide Street East, TORONTO. Phone M. 1608



You Can Put Boiler Corrosion To Sleep And Out of Business

permanently if you really want to. Yes, of course, your feed water is "different" and we "don't know what you're up against." But, as a matter of fact, we **don't** care how bad your feed water is, so long as it is sufficiently liquid to get into your boilers at all. And as another matter of fact, your feed water can't be any worse than in hundreds of other cases that we have met successfully. Furthermore, we **shall** know "what you're up against" in that particular, before we make the first move, because

Bird-Archer Boiler Compounds Are Made For You

put up in the exact proportions of exactly the right remedies to meet the needs of your particular case. No man gets a Bird-Archer Boiler Compound until our Analytical Chemists have examined a sample of his feed water and submitted a written report showing the conditions we have got to meet. We have no "stock" compound. Each case is separately and carefully diagnosed and prescribed for, and the prescription is put up with a degree of care and accuracy approaching that of the most careful pharmacist. These are some of the reasons why

Bird-Archer Boiler Compounds Are Guaranteed

to do the work for which they are compounded. And without the slightest injury to anything but the elements that deteriorate and eventually destroy a boiler.

We have a record almost world wide and many years long for success in treating feed water—a record which justifies our belief that we know **our** business and the feed water troubles of **your** business.

Send us a jug of your feed water at once. Our Analytical Chemist will examine it and submit a written report, without charge, and we will give you, at the same time, an estimate of the cost of the Bird-Archer Compound which your case requires.

Then it will be up to you to buy or not, as you choose, and there will be no hard feelings if you **don't** buy. For unless we can satisfy you that we can do all that we claim, and unless you feel perfectly safe in buying under our liberal, hard and fast Guarantee, we don't want your business

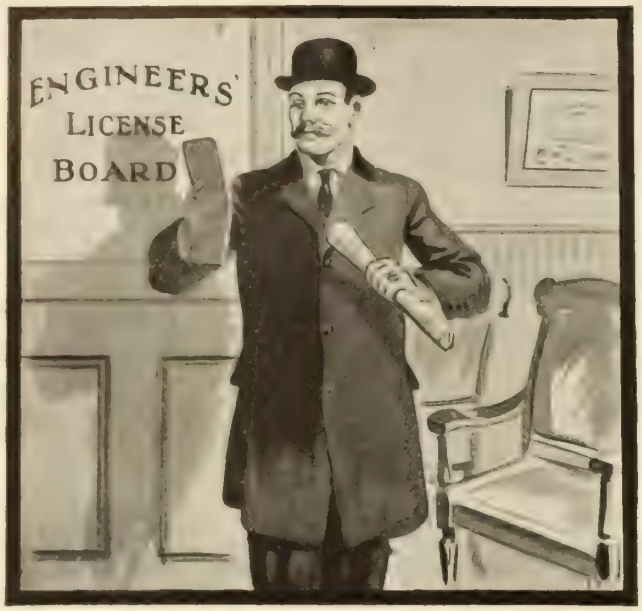
Anyhow, the least you can do, in justice to yourself and your boilers, is to write to-day for a copy of our Guarantee and our Treatise on "Boiler Troubles and Their Prevention," whice IS a Treatise, and not merely an advertisement.

THE BIRD-ARCHER COMPANY

90 West Street, New York

Canadian Representatives: LOWDEN & MEAD, 13 Bleury Street, MONTREAL

QUAKER CITY RUBBER CO. | QUAKER CITY RUBBER CO. | QUAKER CITY RUBBER CO.



"This FREE BOOK Helped Me Get My License."

Send for our book of "Questions and Answers to Engineers' License Examinations," and you, too, will likely be able to say: "This book helped me get my license."

We will send you a copy ABSOLUTELY FREE, if you fill out and mail the coupon, then go to your dealer's and simply ***look at*** (not buy) Daniels' P.P.P. Rod Packing.

How to get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and *look* at Daniels' P.P.P. Packing.

YOUR NAME .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF PACKING USED .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24-F

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

Show the Boss How YOU Can Save Him Money.

The best way to "stand in" with the boss is through saving his pocketbook. The following, from the report of tests made under the direction of the Dean of the Engineering Department of a great American University, tells you how you can "show" the boss:—

"Results show that it required **fifty per cent. more frictional horse-power** to run the engine with high-grade ring packing than that required to run it with P.P.P., and **fifty-nine per cent. more frictional horse-power** to run it with **gum core** packing than with P P.P. Packing, producing a saving by the use of P.P.P., in the case of the high-grade ring packing, of 1.96 horse-power, and a saving over the gum-core of 2.31 horse-power."—"The Story of Some Friction Tests."

If you know the cost per horse-power, per annum, in your plant, you can easily figure the sum that DANIELS'

P. P. P.

ROD PACKING would save in your fuel account each year, running under similar conditions. Are your conditions better or worse?

"Regular"

Three Styles: "Regular," "Speclal," and "Marine." All styles are furnished in Coil, Spiral, and Ring forms.

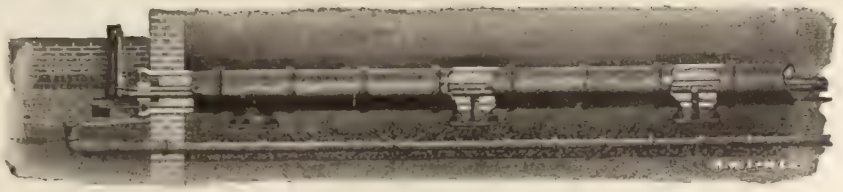
FREE To Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it with the Big red ***D***---cut from the box lid---and we will send you FREE a copy of the book direct. You'll not be required to go to your dealer.

QUAKER CITY RUBBER COMPANY

MANUFACTURER OF MECHANICAL RUBBER GOODS

Philadelphia, Pa., U.S.A.



J-M Sectional Conduit System of Heating with Exhaust Steam

Wood Conduit after one year's service.

With the J-M Sectional Conduit System, exhaust steam can be utilized for heating surrounding buildings, *thus converting waste into profit.* It is the most efficient and economical method of conveying steam underground. Saves 90% of the heat lost in transmission through unprotected or poorly insulated pipes. Pays for itself in a short time in fuel and labor saved.

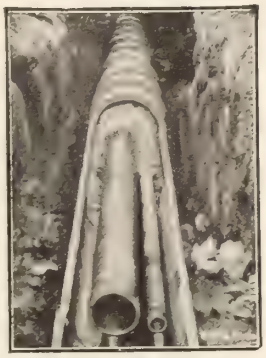
Also unequalled for conveying water, gas or liquids underground.

It is the only *watertight* conduit. Acids, gases and the chemical action of the earth do not affect it. Practically indestructible. Can be taken up and relaid without injury.

These cuts show a comparison of wood and J-M Conduit in actual use and demonstrate the truth of our claim for J-M.

It will pay you to investigate this system.

WRITE NEAREST BRANCH FOR CATALOG



J-M Sectional Conduit after ten years' service.

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of Asbestos and Magnesia Products. ASBESTOS Asbestos Roofings, Packings, Electrical Supplies, etc.

Toronto, Ont. Montreal, Que. Winnipeg, Man. Vancouver, B.C.

For the United States—H. W. JOHNS-MANVILLE CO.

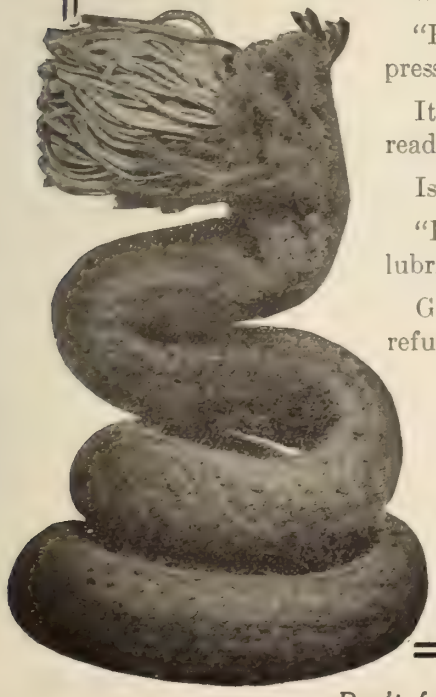
Baltimore	Cleveland	Kansas City	Minneapolis	Philadelphia	Seattle
Boston	Dallas	Los Angeles	New Orleans	Pittsburg	St. Louis
Chicago	Detroit	Milwaukee	New York	San Francisco	

728

Will you give

Premduro Packing

a thorough service test ?



We know just how good it is, and would like to have *you* convinced also.

"PREMDURO" contains no asbestos or rubber that scored rods or high pressure can affect, and is absolutely non-heating and non-scoring.

It is composed of triangular soft metal wires of special composition, and readily adapts itself to any surface.

Is simple to insert and costs less than any other efficient packing.

"PREMDURO" PACKING will be found to be very durable and is self-lubricating.

Give "PREMDURO" a fair trial—that is all we ask. We will cheerfully refund your money if it won't do all or more than we claim for it

Write for samples, literature and prices

Premier Engineering & Mfg. Co.

25 Broad Street, New York

QUALITY

Counts in

Gauge Glasses

Bishops ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

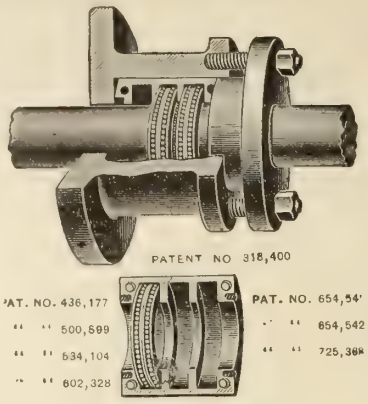
ADAMANT GLASSES

have been tested under all conditions and have proved their superiority over all others.

Write us for Further Particulars

J. R. Baxter & Co.

Mill Supplies MONTREAL



PATENT NO 318,400

PAT. NO. 436,177 " " 500,599 " " 534,104 " " 602,328

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Why not Buy the Best, when in market for Packing?

HOLMES'

Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

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of any American or Foreign technical or trade journal furnished on short notice at moderate rates; also newspapers and magazines; all kinds of Government and State Reports in stock. Clippings on special subjects furnished promptly.

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263 Armstrong Ave., Jersey City, N.J., U.S.A.

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

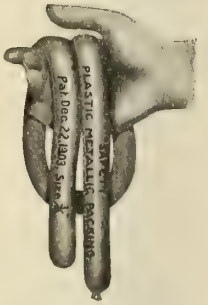
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

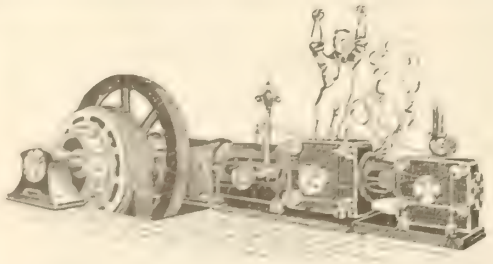
Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless



Sold on APPROVAL



ARE YOU HAVING THIS TROUBLE?

IF SO, PACK WITH

Rhodes Metallic Packing

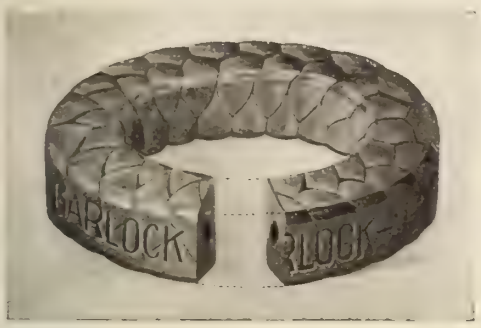
We will warrant you have no more trouble for at least one year. It is a packing which you instal and forget

AGENTS WANTED

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

c o C. W. SPENCER & CO., 55 St. Francois Xavier Street, Montreal, Quebec.



Ring Form

GARLOCK

Waterproof Hydraulic

Specifically adapted and guaranteed to do the work required on cold water pistons, plungers on cold water pumps, elevator cylinders, cold oil, and brine.

Write for Garlock Catalogue.

The Garlock Packing Co.

Toronto HAMILTON Montreal

Pioneers in the Packing Business.

Spiral Form.

ASBESTOS & RUBBER GOODS CO.

Mill, Factory and Steamboat Supplies

141 KING STREET EAST - - - TORONTO

BEAR STEAM PACKING for Piston and Valve Rods. Its advantages over other steam packings are perfect elasticity, and the fact that it reduces friction to the lowest possible limit, hence a great saving in engine power, or a proportionate saving in fuel.

BEAR PUMP PACKING. High pressure, suitable for any class of pumps or hydraulic machinery, has given every satisfaction up to 2,000 lbs. pressure per square inch.

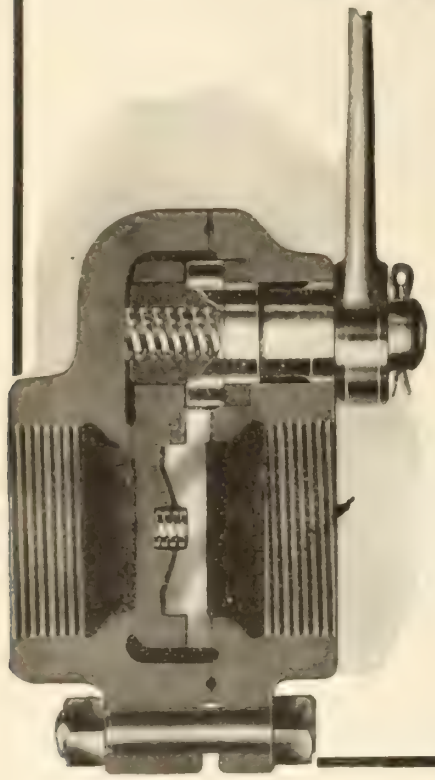
"VINCO" BALATA BELTING. made of the ***best cotton duck,*** and pure balata. Stocked in sizes from 1½ to 14 inches.

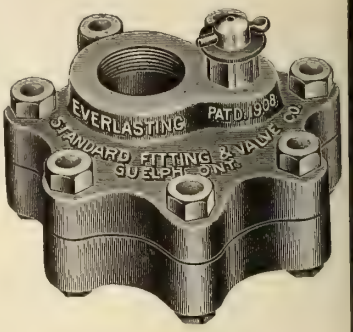
We also carry a full stock of all other Engine Room and Machinery Supplies, and we are specially equipped for the making of all sizes of ASBESTOS GASKETS.

See us before placing your order.

"Everlasting" Blow-off Valves

STOP THAT LEAK





Every boiler has a Blow-off Valve that may be a certain loss to YOU.

WASTED STEAM means wasted fuel.

Experience has proved that most Blow-off Valves leak. How about yours?

WORDS FROM PRACTICAL MEN

Standard Fitting and Valve Co., Ltd., Guelph, Ont. — Ottawa, Can., Feb. 9, 1911.

Gentlemen,—Referring to yours of the 6th with regard to Blow-off Valve. We had one of your Blow-off Valves inspected by a number of engineers, all of whom spoke very highly of its mechanical principles and voiced themselves as perfectly satisfied that it is much superior to any Blow-off Valve they had seen before. We then put this valve into actual service, where it has given entire satisfaction, and as a result of these reports we intend to carry a stock. Yours truly,

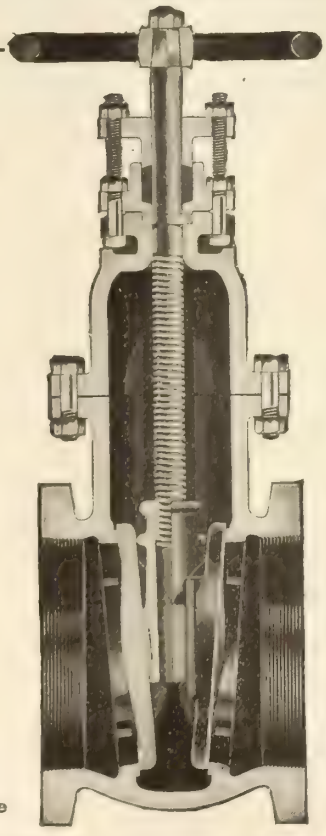
The General Supply Company of Canada, Limited,
G. B. Greene, Jr., Manager.

Standard Fitting and Valve Company, Ltd.

GUELPH - - ONTARIO

Type "K"

Iron Body



Gate Valves

Bronze Mounted

Tested to 300 pounds hydraulic pressure.

Elliptical in design.

Double compensating bronze-faced discs.

Can be re-packed while under pressure and wide open or closed.

Parts interchangeable.

Discs cannot jam.

Possess wide margin of safety.

Stocked by jobbers and dealers everywhere

Suitable for 125 pounds working steam pressure.

Design insures great rigidity and strength.

Heavy bronze seat-rings screwed into body and renewable.

Bronze disc-rings forced into double grooved recesses in discs.

Can be operated in any position.

Handsome appearance.

Dependable in service.

SEND for TYPE "K" Booklet

JENKINS BROS., Limited, Sole Manufacturers

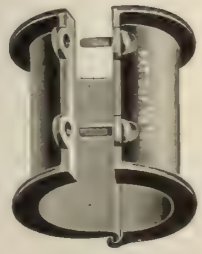
103 St. Remi Street - - - MONTREAL

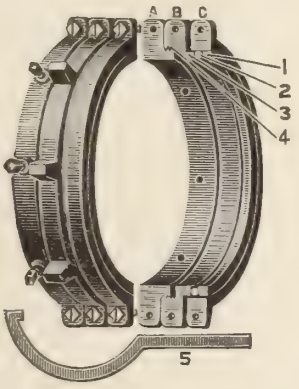
The advertiser would like to know where you saw his advertisement—tell him.

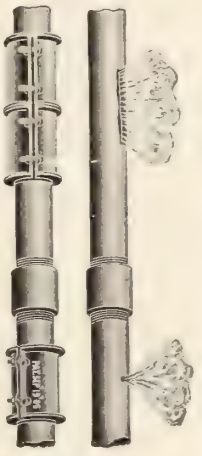
FOR EMERGENCIES LIKE THIS

EVERY ENGINE ROOM
SHOULD HAVE A FEW

Emergency Pipe Clamps

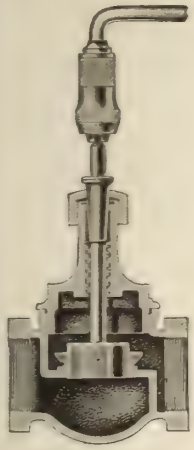






They are inexpensive and very effective in stopping steam or water leaks.

Thousands of these clamps are in use. Order now, so when the occasion arises you will have them on hand, as you will need them badly.



Skinner Valve
Reseating Machine

Stop Those Valves Leaking

SKINNER VALVE RE-SEATING TOOLS

Will pay for themselves on the first few valves saved without disconnecting from the pipes. Every plant using valves should have one. They are the best reasonably priced tools on the market; the cost of replacing two 2-in valves on the pipe represents the price of the Tool.

The Canadian Fairbanks Co., Limited

Fairbanks Scales—Fairbanks-Morse Gas Engines—Safes and Vaults.

Montreal Toronto St. John, N.B. Winnipeg Saskatoon Calgary Vancouver

Ever troubled with leaky Pipe Joints?

Try Dart Unions—
They CANNOT leak

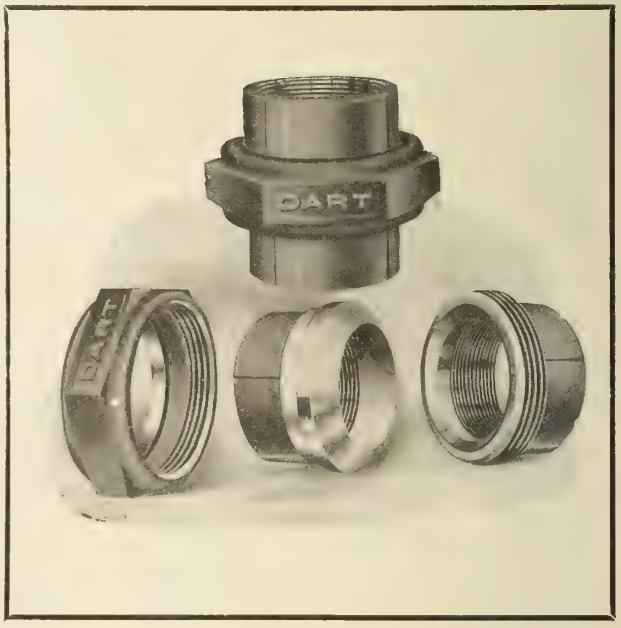
Dart Unions, both flanged and screwed types, are made in two heavy iron sections, threaded absolutely to standard.

Both sections are seated with smoothly-ground bronze.

These sections meet in a bronze-to-bronze ball joint that is proof against rust, corrosion or any other form of decay.

Dart Union joints can be made with great speed, whether pipes are in or out of line.

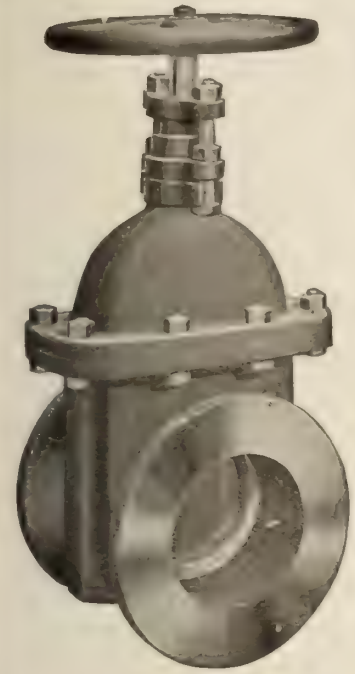
And they can be connected and reconnected time after time without injuring the efficiency of the union.



Try Dart Unions

Your experience will confirm our assertions. Your dealer can supply them.

Dart Union Co., Limited
Toronto - - - Canada



Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

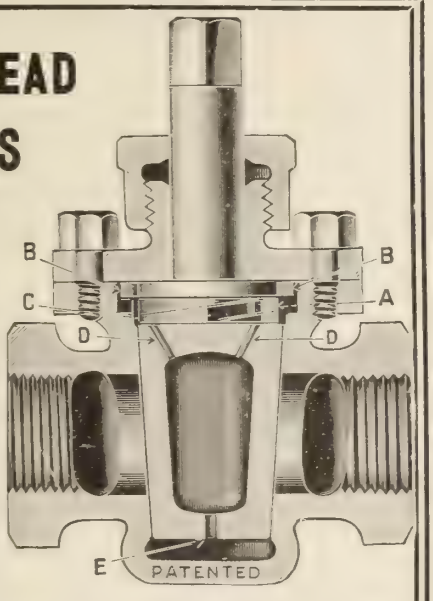
The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO

HOMESTEAD VALVES

Have no Equal for Simplicity and Durability



They are unexcelled for any service involving the handling of high pressures in steam, gas, water or hydraulic work. The seats are absolutely protected against wear. The plug is balanced and held in place by pressure when open, and when closed it is locked in the seat by our patent wedging cam That's what makes Homestead Valves outwear all others.

A quarter turn opens or closes the valve---no waste of time or energy.

A catalogue describing Homestead Valves is yours if you'll tell us where to send it.

Homestead Valve Mfg. Co.
Works: HOMESTEAD, PA.
P.O. Box 1754, Pittsburg

Nelson Steel Gate Valves for Superheated Steam

YOU cannot consider Economy through superheated steam without considering *Equipment for Economy's sake.*

Your economy is *greatest* when your Equipment is *best*, running smoothly, constantly, safely—*have you experienced that?*

Or have you found the leaks serious, the shut-downs frequent, and repairs expensive, so that your *Economy Pride* has been supplanted by an *Abnormal Expense Spectre?* We trust you will *never* experience that.

And yet, if you *have* failed to find a valve on which you can, with confidence, impose the severe strains and stresses of superheated steam, then—

Our mission, in this friendly page of POWER HOUSE, is to invite you to look into the merits of the Nelson Steel Gate Valve for superheated steam—*for Economy's Sake!*

We would have you investigate it thoroughly from every standpoint your experience would suggest—for strength to stand the extreme stress; for combination of metals that expand and contract just right; for a mechanism that harmoniously adapts itself to any condition, extreme or otherwise; for ease and comfort of operation; for convenience of packing; and for the record they have made in actual service under as hard conditions as they would ever experience in your service.

We would have you do this piece of inspection so critically that you would *be sure*—remembering, too, that our guarantee accompanies every valve we sell.

Come see the valves under construction in our plant, built as carefully as a Corliss Valve gear is built, built for endurance, built not cheaply, but built *right—for Economy's Sake.*

Made as carefully as the finest piece of Machinery in your plant. Time-tested Nelson discs are the simple—and effective—mechanism that keeps valve tight, adjusting themselves to contraction by cold, to expansion by heat, or any other distorting influence. Best of cast irons or ordinary steels are too weak—therefore we use the strongest—*Acid Open Hearth Steel.* Bronze valve fittings disintegrate—therefore in all working parts we use Monel, the strong metal that cannot weaken or corrode. Thus you have a valve more than 65000 lbs.-per-sq.-in.-strong at every point, *reliable, safe,* for temperatures up to 800° F. *Absolute, thorough* inspection of every detail, *most rigid testing of every part from start to finish.* Test certificate plate fastened to each valve.

Make them strong! Spare no care!! Must be right—and tight!!! Test them hard!!!! These are the watchwords that govern their construction.

Nelson Valve Company
PHILADELPHIA

MONTREAL	NEW YORK	CHICAGO	SAN FRANCISCO
12-14 University St.	30 Church St.	17 West Kinzie St.	22 Battery St.
PITTSBURGH	MINNEAPOLIS		BUTTE
517 Liberty Ave.	622 Andrus Bldg.		50 E. Broadway

Nelson Valves are made in the Gate, Globe, Angle and Check types, in all sizes, of Iron, Bronze, or Steel, for all pressures, for any service.

If your dealer hasn't complete stock, write nearest Nelson office—WE WILL TAKE CARE OF YOU.

YOU CAN'T GO WRONG

WHEN YOU SPECIFY

Lunkenheimer Oil and Grease Cups

THEY ARE MADE OF THE HIGHEST GRADE OF MATERIALS AND ARE VERY STRONG, PARTICULARLY IN THE SHANK, THE PART SUBJECTED TO THE GREATEST STRAIN.

JARRING OF THE MACHINERY TO WHICH THEY ARE ATTACHED WILL NOT SHAKE THEM TO PIECES, NOR WILL IT AFFECT THE SETTING OF THE FEED.

ALL CUPS ARE EASILY FILLED AND THE SIGHT-FEEDS ON THE OIL CUPS ARE LARGE, PERMITTING THE OIL TO BE SEEN FROM QUITE A DISTANCE, AND DO NOT EASILY BECOME OIL SPLASHED.

LUNKENHEIMER LINE OF OIL AND GREASE CUPS IS A VERY LARGE AND COMPLETE ONE, AND AMONG THEM CAN READILY BE FOUND A CUP PARTICULARLY ADAPTED TO SUIT ANY REQUIREMENT.

"Most supply houses sell them—yours can—if they dont or wont—tell us."

The Lunkenheimer Company

Largest Manufacturers of High-Grade Engineering Specialties in the World

General Offices and Works: CINCINNATI, OHIO, U.S.A.

CHICAGO	NEW YORK	BOSTON	LONDON, S.E.
186 North Dearborn Street	64-68 Fulton Street	138 High Strreet	35 Great Dover Street

Get the Genuine

Does the reputation of Detroit Lubricators mean anything to you?

Does the fact mean anything to you that one and a quarter millions of Detroit Lubricators are giving satisfaction all over the world?

Nine-tenths of the prominent engine builders furnish Detroit Lubricators with their machines because they know the life of any machinery depends upon its lubrication. Everywhere engineers who know insist on the installation of genuine Detroit products.

This world-wide demand for Detroit Lubricators is the demand for quality.

Imitators are making lubricators that look like the Detroit and are trying to sell them on the strength of their looking like the Detroit.

Sometimes these imitations are sold as being "Just as good as the Detroit." If they were as good, they would be sold on their own merits and not on the established reputation of the Detroit.

Sometimes these imitations are substituted when a "Detroit" is asked for. To prevent your getting an imitation and assist you in identifying the genuine, we have marked every package with this mark of quality. Be sure you get the genuine.

TRADE MARK
REG. U.S. PAT. OFF.

Catalog G tells all about genuine Detroit products. Write for it.

DETROIT LUBRICATOR COMPANY.

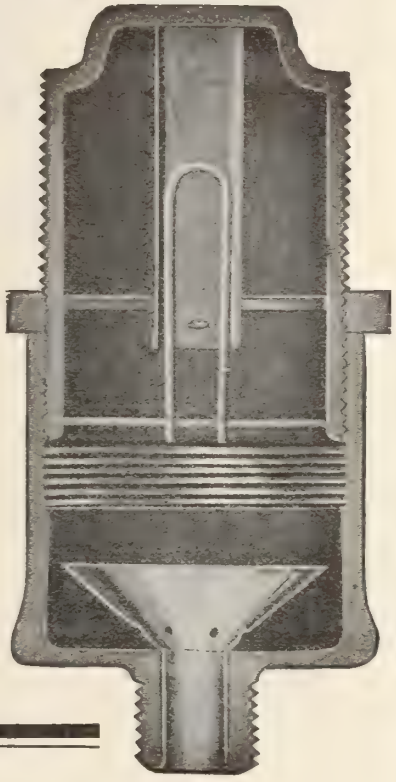
DETROIT, U.S.A.

Largest manufacturers of lubricating devices in the world.

The advertiser would like to know where you saw his advertisement—tell him.

Uniform Pressure to the Last Drop of Grease

This is the "Philadelphia" Grease Cup



This desirable result is obtained in the only automatic Grease Cup on the market in which compressed air is the feeding force—the

"PHILADELPHIA" GREASE CUP

And for this reason it is not affected by centrifugal force when used on loose pulleys, and is equally positive in action in whatever position placed.

The "PHILADELPHIA" is absolutely dust-proof, increases efficiency and decreases expense. It has been tried out and proved to

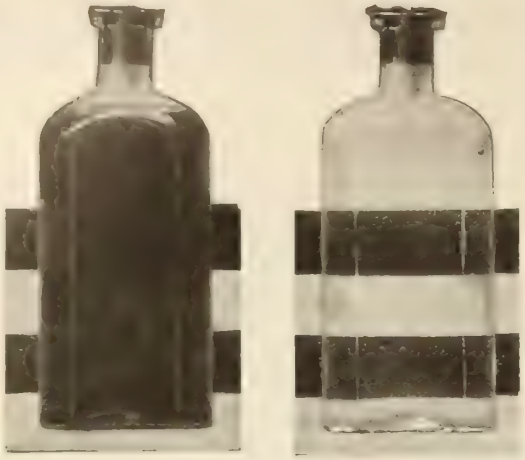
SAVE TIME AND LABOR

and it operates effectively without requiring attention.

WRITE FOR PRICE LISTS AND DISCOUNTS

PETERBOROUGH LUBRICATOR MFG. CO., LTD.

PETERBOROUGH, ONTARIO



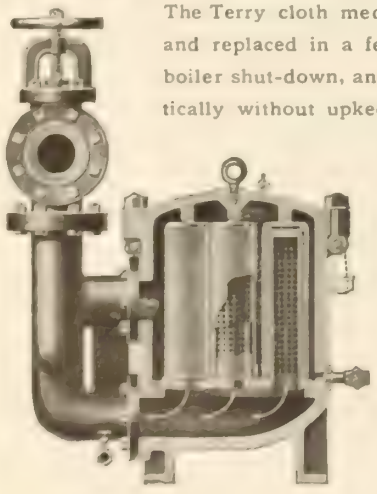
MAKE WATER LIKE THIS

CLEAN LIKE THIS

You can with the Blackburn-Smith Feed Water Filter and Grease Extractor.

THESE samples indicate a clarifying efficiency characteristic of the Blackburn-Smith Filter, for hundreds of our installations are doing perfect work on worse waters where other filtering and "separating" devices failed. By putting one of these filters in the feed line you can use exhaust condensation and muddy river water, together or separately, without the slightest danger of letting oil from the former or mud from the latter into the boilers.

No other device compares with the Blackburn-Smith for filtering efficiency, compactness and ease in cleaning. The Terry cloth media can be removed and replaced in a few minutes without boiler shut-down, and the filter is practically without upkeep expense, as the media can be washed and used over and over.



Our booklet, "FEED WATER FILTRATION," contains information on this subject that is worth your reading.

Send for a copy.

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Toronto Winnipeg Vancouver Ottawa Quebec

WE are handing out a new book on Lubrication for the Big Men in the Power Field.

Who are the *Big Men?*

Every engineer who is ready to learn of more complete, more economical, more modern methods of lubrication.

Every man who realizes that the world moves and wants to keep up with the best.

A postal asking for this book No. "N" will bring you your copy. If you will tell us the size of your engine and quantity of oil used we can suggest methods for better lubrication with less oil.

"Everything for Lubrication but the Lubricants."

The Richardson-Phenix Co.

Largest Exclusive Manufacturers of Oiling Devices

Works: Milwaukee, Wis.

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Something New

Do not fail to ask for prices on our strictly high-grade Glass Body Oiler Pressed top and bottom.

This is a strictly high-grade Oiler. Handsome and neat. Stronger than a cast cup, and cheaper.

We can give you this cup in buff finish or satin finish as you prefer. Do not hesitate to ask for prices or samples.

Manufactured only by

American Lubricator Co.

Detroit, Mich., U.S.A.

Removing the Appendix

Would you have this operation performed by some doctor who offered to do it cheap or by an experienced, successful specialist? We know the answer.

The same principle applies in many other directions. There has been a wonderful change in the intellectual broadening of operative engineers and mechanics. They are no longer satisfied with merely keeping the machinery in good running order. They start in at the coal pile and study the califoric power of fuels in thermal units, the firemen are put through a school of instructions, and they study economies and scientific problems in many other directions.

BUT

how many engineers and mechanics figure on the loss from frictional resistance in transferring the power from the boiler to the points where it is needed?

More than half of the power is often absorbed in that way, and yet many up to-date men use, or permit to be used, the most ordinary grades of babbitts because of the slight initial saving in the cost price.

It is as Plain as an Open Book

that the value of a genuinely good and economical bearing metal is summed up in and expressed by a low co-efficient of friction.

A low co-efficient of friction means less frictional resistance, less wear, less heating, less oil, less fuel, less liability of shut-downs, less rebabbitting, less consumption of metals, less squashing, less worry, less work.

You can secure all of these economies and other advantages by the use of

MAGNOLIA METAL

and we recommend its uses on shafting as well as all other bearings. We represent the specialist who does one thing, and does it well.

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SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK: 680 pages, over 2000 subjects up to date. We do not aim to make a profit on this book, therefore offer it at the very low price of 40c., postage paid. Many engineers have written to us that it is invaluable. Address Montreal office.

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We have been appointed Canadian Representatives for

THE RICHARDSON-PHENIX CO.

Largest Manufacturers of Oiling Devices in the World

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JOSEPH T. RYERSON & SON

Largest Iron and Steel Merchants in the World.
A Complete Line of Iron-working Machinery

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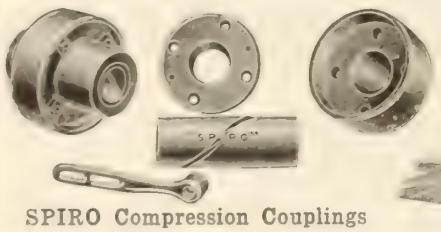

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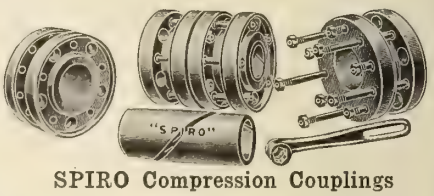
Make Your Assurance
"DOUBLE SURE"
and Take a Bond.



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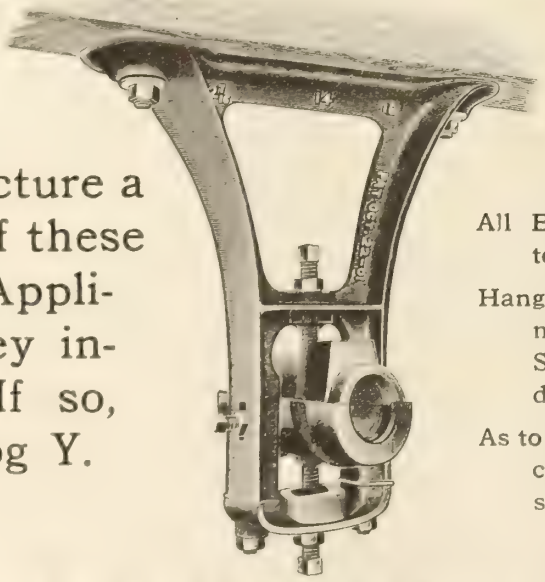


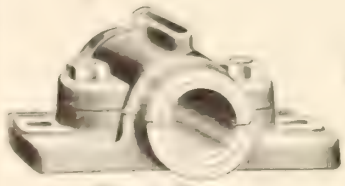
We manufacture a complete line of these Transmission Appliances. Do they interest You? If so, write for catalog Y.

A Few of Their DISTINCTIVE FEATURES:

All Bearings REAMED accurately to shaft size.

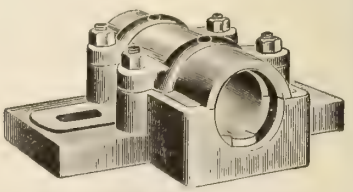
Hangers have Universal Adjustment, Case Hardened Steel Set Screws, and a symmetry of design that appeals to the user.

As to the Couplings, look them over carefully. They tell their own story.



Clamp Boxes

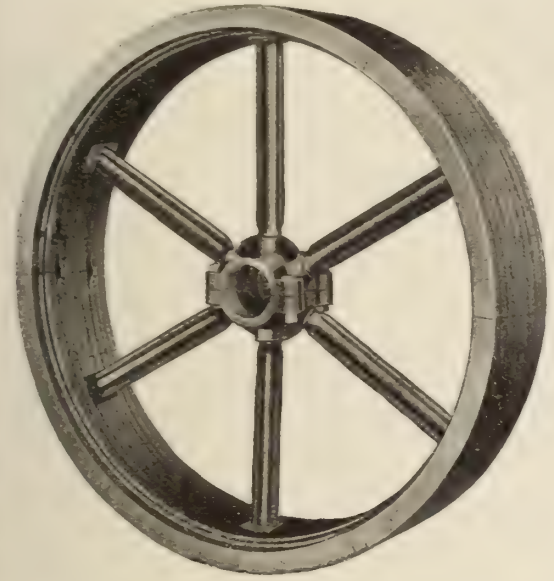
Canadian Bond Hanger & Coupling Co.
LIMITED
Sole Manufacturers of
DOUBLE SURE POWER TRANSMISSION
Alexandria : Ontario : Canada



Rigid Ring Oiling Pillow Blocks

The advertiser would like to know where you saw his advertisement—tell him.

When you buy
"POSITIVE" Combination Split Pulleys
you get all that it is possible to get in any Pulley.



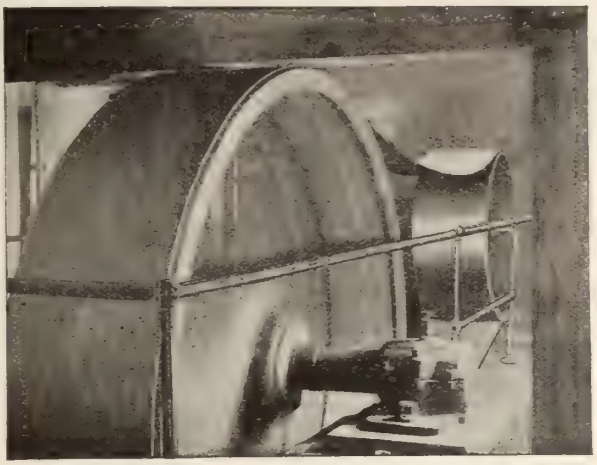
Mechanically correct in design.

Made of the finest materials available.

Combines more good features than all other pulleys put together.

Will transmit more power and consume less power than any pulley made.

POSITIVE CLUTCH & PULLEY WORKS
LIMITED
11-13 Jarvis St. - - Toronto



Your Leather Belts are Only Animal Matter. Will You Let Them Perish Quickly, or Will You Preserve Their Health and Vigor?

Because the belt maker puts everything necessary into a leather belt doesn't mean that the belt needs no further treatment. Granting that a belt is turned out in the best possible condition, how long should you expect mere animal tissue, unaided, to carry a tremendous load, often run at the speed of a locomotive and be bent back and forth hundreds of times per minute? You know that such treatment simply **must** produce friction between the fibers and you know that the heat so produced and its effects are not lessened by the hot dry air in which the belt usually works. Doesn't it stand to reason that the natural, oily ingredients of the belt will burn out and that those consumed should be replaced by some equivalent? Leather belting **must** be fed and protected from wear and tear on its tissues or it must die before its time, just the same as a human being. No belt can stand up to tremendous physical work for months without help, without showing the strain sooner or later, usually sooner.

Unfortunately, power users often think that if the belt can be made to stick to the pulleys, everything is all right. In other words, the belt is whipped up to do more work instead of being put into better physical condition so it can work.

This is just what happens when some preparation is applied merely to change the character of the belt face. Most preparations do not give back to the belt what is taken out by actual work. Some do actual harm. Rosin, for instance, temporarily stops belt slip, but in view of the drying action upon the fiber, its use is criminal.

Here is where the action of Cling-Surface is radically different, for Cling-Surface **lubricates** and **preserves** the interior fibers. The soft, velvety, moist surface which it imparts to the belt, and the consequent power of the belt to hug the pulleys without slip are merely secondary results of its use. Fundamentally, Cling-Surface is a belt food, a basis for scientific belt treatment to lengthen belt life and put the belt **internally and externally** in the best physical condition to produce **constant** and **ultimate** high transmission efficiency.

That it does this and does it well can be inferred from its use year in and year out in thousands of America's most prominent power plants. We will gladly refer you to many in your own neighborhood, but better try Cling-Surface at our risk. If the results do not justify our claims, the Cling-Surface used will not cost you one penny. Write for literature.

Cling-Surface Co
1057 Niagara Street - Buffalo N Y

GOOD BELTING

Is Known by Its PAST RECORD

D. K. McLAREN'S

Genuine British Oak-Tanned LEATHER BELTING

has a record of performance.

It is a Belting of the very finest quality in material and workmanship.

Our reputation has been built up by this grade—a "Belting that does the work."

In all our lines you will always find the same uniformly "best quality."

Under our most rigorous system of inspection and classification of hides and leather only the choicest parts of the hides are ever used in the manufacture of McLaren's Belting.

The hides are carefully trimmed BEFORE being tanned.

More solid Belting to the foot than in any other Belting made.

Write for Catalogue

D. K. McLAREN, LIMITED

MONTREAL
351 St. James Street

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200 King Street West

QUEBEC
21 St. Peter Street

ST. JOHN, N.B.
64 Prince William Street

VANCOUVER, B.C.
37 Alexander Street

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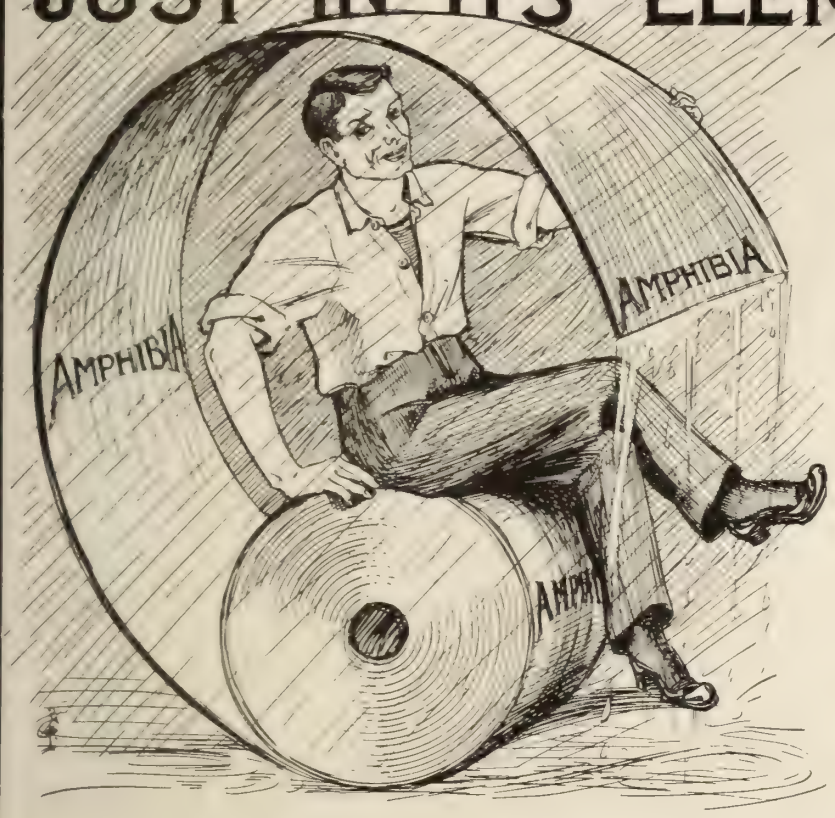
JUST IN ITS ELEMENT



WATER WON'T HURT

"AMPHIBIA"

Waterproof LEATHER BELTING

How are You Getting Your Belt Wisdom?

Are you paying for knowledge in a succession of poor or unsuitable Belting, or have you discovered

"Amphibia" Waterproof Belting?

This Belt we can safely guarantee. For out of the thousands of feet shipped each year we have no complaints to adjust.

"AMPHIBIA" satisfies. It is a Belt for unusual service—where it is damp, and must run out of doors; where the strain is heavy and the care scant. For every difficult place use "AMPHIBIA."

It costs no more than ordinary kinds, but it is the premier of them all.

A Great saving in Sawmills, Brickyards, Pulp Mills, Tanneries, Woolen Mills, Breweries, Laundries, All Wet Places.

Sadler & Haworth

ESTABLISHED 1876

MONTREAL, 511 William Street TORONTO, 27 Melinda Street

ST. JOHN, N.B, 89 Prince William Street WINNIPEG, 244 Princess Street. VANCOUVER, B.C., 217 Columbia Ave.

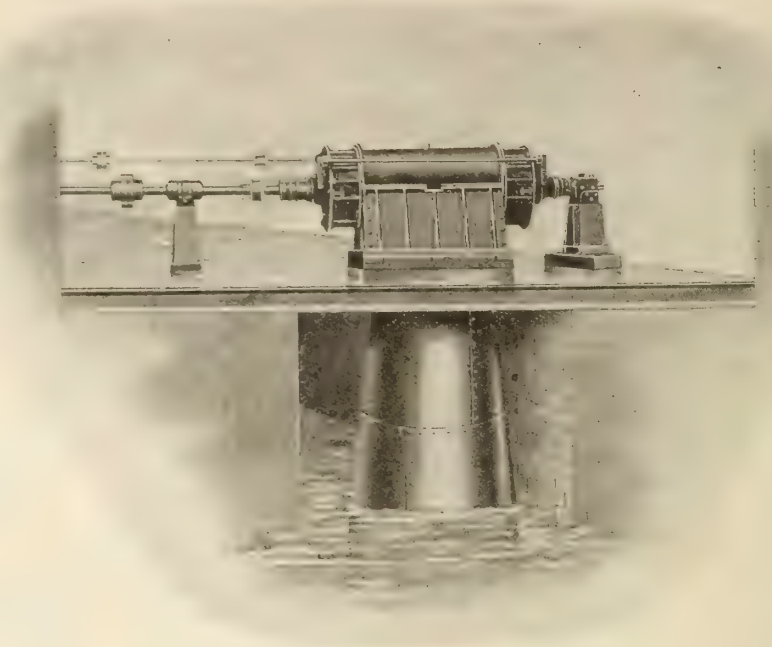
☞ TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN ☜

The CANADIAN TURBINE

is eminently adapted for

Mill and Factory Drives and Electric Plants

You are always sure of good, practical results in Power, Economy and Easy Governing.



Horizontal Pair—Centre Discharge.

With "The Canadian Turbine" and the experience we place at your disposal you are absolutely assured that you have all that can be got out of your water privilege

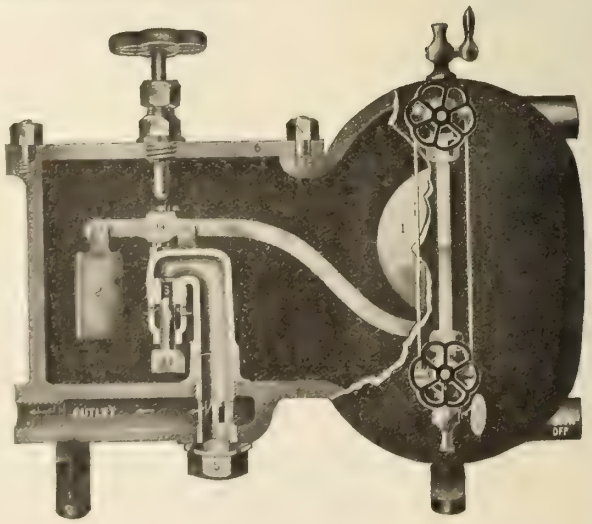
Chas. Barber & Sons - Meaford, Ont.

For Economy and Efficiency Use Sterling Traps.

The Sterling Steam Trap

Model E

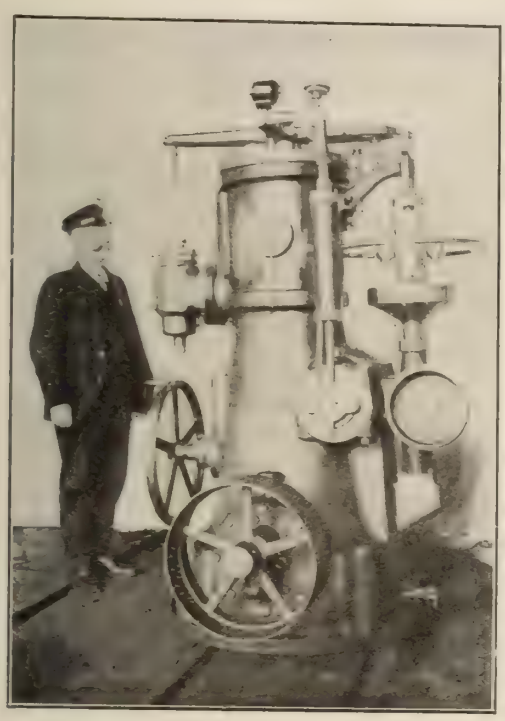
We have a host of satisfied customers in the United States. We invite you to join their number and rid yourselves of steam trap worry. The advantages of the STERLING TRAP are greater discharge, capacity and elimination of wire drawing in valve. We guarantee to furnish you without cost any part of this trap that does not work satisfactorily within six months from the date of sale. Sold by all dealers. Buy a trap large enough to do your work and take care of emergencies.



Write to-day for Catalogues.

GOULDS PUMP COMPANY

National Trust Bldg., TORONTO, ONT. Coristine Bldg., MONTREAL, QUE.



GOVERNORS

THIS picture shows one of the Governors we supplied to the Calgary Power Co. for regulating the speed of a 3750 H.P. Turbine. It is the **most compact** and **reliable** governor on the market. Notice the **absence** of all racks and pinions—things which are liable to **wear out very soon**. Note also the **presence** of a **guide bearing** on the top of the flyball shaft—very seldom used on Governors of other makes.

We manufacture seven different sizes of Governors suitable for all conditions.

The Canadian Boving Company, Limited

164 BAY STREET, TORONTO

BELLISS

AIR COMPRESSORS

STEAM OR MOTOR DRIVEN.

Equal in workmanship to the Belliss Engine.

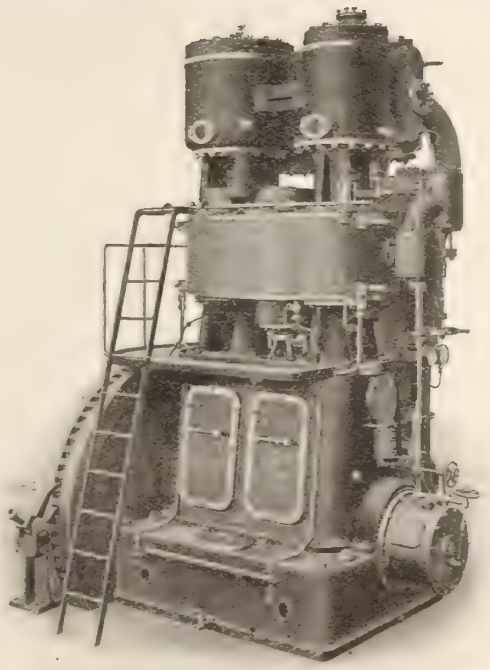
GIVE UNEXCELLED SERVICE.

FORCED LUBRICATION.

NO HOT BEARINGS.

Economy and Efficiency set a new standard in Air Compressor practice.

Write us for descriptive pamphlet.



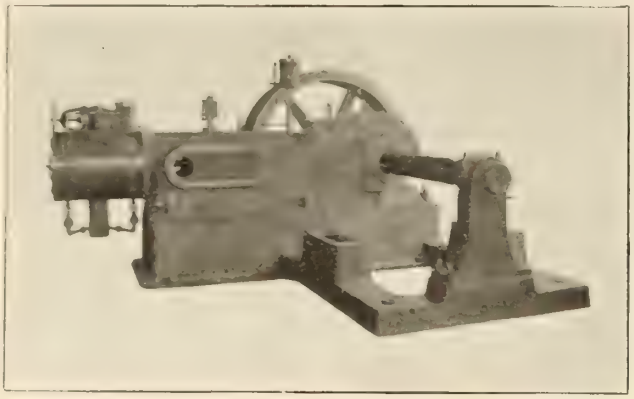
Laurie & Lamb, 211 Board of Trade Building Montreal, Que.

CONSULTING AND CONTRACTING ENGINEERS.

Sole Agents for BELLISS & MORCOM, Limited, Birmingham, England.

Leonard Automatic Engines

Arranged for Direct Connection to Electric Generators. Particularly Adapted for Electric Light Service where Floor Space is Limited.



One of our customers writes as follows:—

"I have had excellent satisfaction with your Automatic Engine, which has been in constant use for nineteen years, during which time have not paid out anything for repairs, except for a few minor parts that wear, such as Piston Rings. Engine is still giving good service, running quietly, with the same remarkable fuel economy."

We have a great number of engines the same type as the above throughout the whole of Canada, giving the same satisfactory service.

MADE BY

E. LEONARD & SONS, London, Ontario

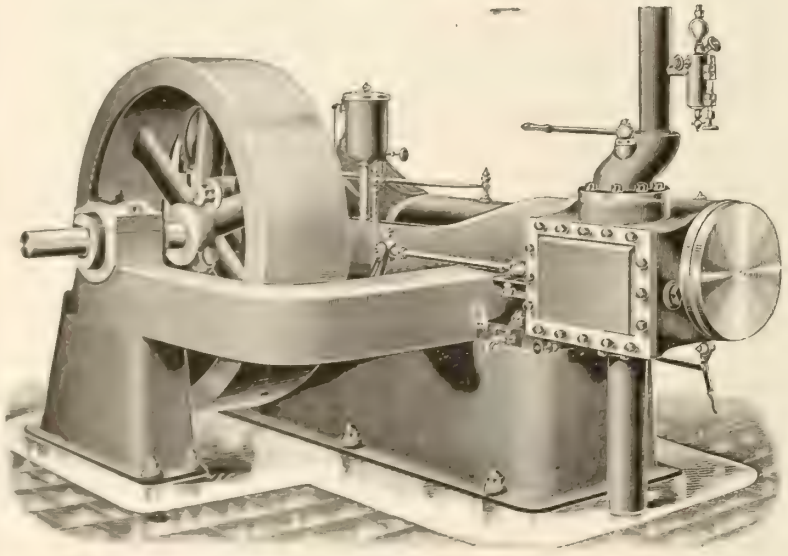
Manufacturers of High and Slow Speed Engines of all kinds, Boilers, Heaters and Complete Steam Plants.

Canadian Agents for "National" Gas Engines and Producers and "Browett-Lindley" High Speed English Engines.

Warehouses and Agencies at

MONTREAL, QUE. ST. JOHN, N B. CALGARY, ALTA. WINNIPEG, MAN. VANCOUVER, B.C.

BEARINGS IN LINE



In sizes up to 125 horse-power, the outboard bearing of our side-crank engines is connected to the frame by a wing, keeping the bearings perfectly in line.

These engines are built on the interchangeable system, and duplicate parts are kept in stock, ready for shipment on receipt of order.

They have our latest improved governor and oiling system and are strictly high class in every respect.

Robb Engineering Co. LIMITED

AMHERST, N.S.

DISTRICT OFFICES

Canadian Express Building, Montreal	R. W. Robb,	Manager
Traders Bank Building, Toronto -	Wm. McKay,	"
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Grain Exchange Building, Calgary -	J. F. Porter,	"

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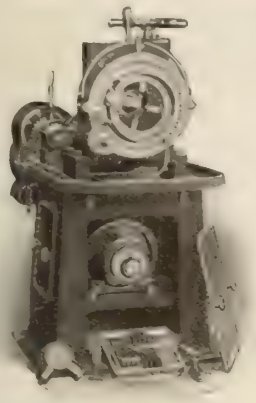


THE FORBES PIPE CUTTING AND THREADING MACHINE, motor drive, motor inside the base protected from oil or breakage.

Constant speed motors used and various speeds obtained by lever control.

Triple compound spur gears cut from solid castings.

Oil pump direct connected, no belting.

No loss in friction, self-contained work done on the spot.

WRITE FOR CATALOGUE

The Curtis & Curtis Co.

26 Garden Street : Bridgeport, Conn.

MONCRIEFF'S

GAUGE GLASSES

Have proved their Superiority over all others by conclusive tests made by the largest

RAILWAY COMPANIES AND POWER PLANT OWNERS

Get full particulars from their Canadian Representative

W. J. WALL, 134 Bleury St., Montreal Que.

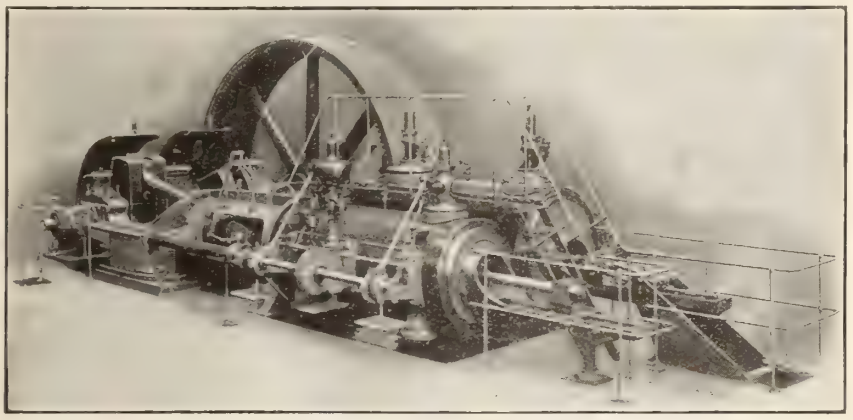
CARELS DROP VALVE STEAM ENGINES

for HIGHEST ECONOMY and RELIABILITY

Sole Licensees for Great Britain and the Colonies

Douglas & Grant

Kirkcaldy, Scotland



700 I.H.P SIDE-BY-SIDE ENGINE, WITH CARELS DROP VALVES

Also makers of CORLISS Engines

Aero Condensers. All water recovered, none required for condensing, and heated air obtained for manufacturing purposes.

SURFACE and JET CONDENSERS, Etc.

STEAM and ELECTRIC HAULING and WINDING GEARS.

Large Pumps for WATERWORKS and MINES.

On British Admiralty and India Office Lists.

AGENTS FOR CANADA:

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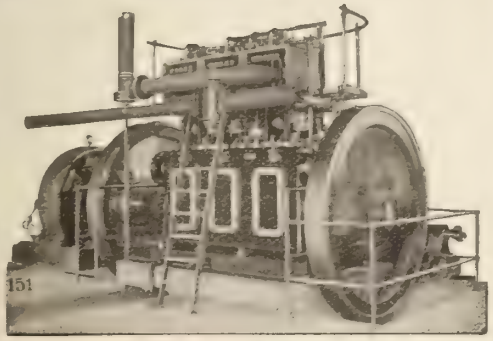


Reduce the Cost of Power

Investigate the merits of our Gas Engines. Give our Engineering Staff a chance to show you that they can reduce your power cost. Send for our Data Sheet of Estimate Cost of a Power Plant.

GAS ENGINES

We manufacture both **Vertical** and **Horizontal** Types, and guarantee results by use of either **Natural Gas, Producer Gas,** or **City Gas.**

The Canada Producer & Gas Engine Co., Limited

S. DYMENT, President BARRIE, ONTARIO E. J. GRAVES, Managing Director

The advertiser would like to know where you saw his advertisement—tell him.

MANUFACTURERS SHOULD HAVE

An Economical Power Plant

To obtain this you must investigate the conditions which exist in your own plant.

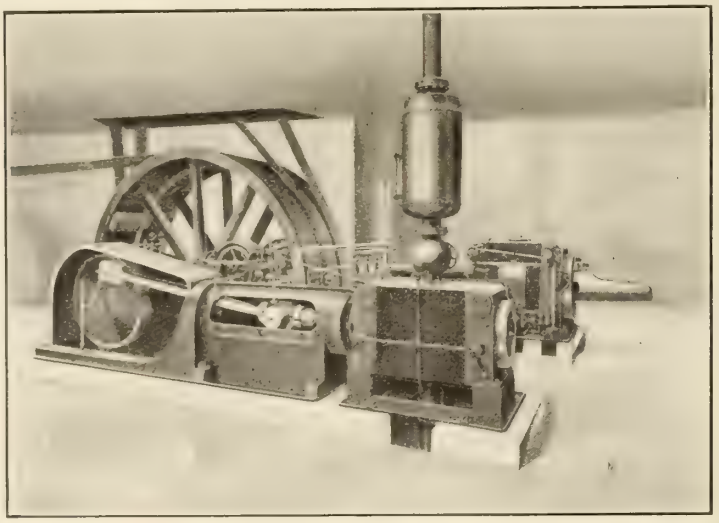
Does your plant require heating? Do you require steam for manufacturing processes? All plants require more or less heat seven months out of every twelve. Would you consider it an economy to maintain a separate heating plant during this seven months? We think not.

If You Have a Good Steam Power Plant, Your Exhaust Steam Will Pay Your Heating Bills.

GOLDIE CORLISS STEAM PLANTS

GIVE YOU A MAXIMUM SERVICE AT A MINIMUM COST.

Steady Service is a matter of vital importance. No power is so dependable as a good Steam Engine.



They will run 24 hours a day and 365 days a year and you don't have to pay a peak load rate. They save you money.

Plant of Cosmos Cotton Co., at Yarmouth, N.S., equipped by us with Cross Compound Goldie Corliss Steam Engines, Rope Drive.

Goldie Corliss Steam Engines

are splendidly designed, built of the best material, are very rigid, and are fitted with the **Rites Inertia Governor**, which gives the closest regulation obtainable on Engines of the Heavy Duty Type.

ASK US FOR ALL PARTICULARS, PRICES, CATALOG, ETC.

The Goldie & McCulloch Co., Limited

GALT - ONTARIO - CANADA

WESTERN BRANCH
248 McDermott Ave., Winnipeg, Man.

MARITIME PROVINCES
13-15 Dock Street, St. John, N.B.

QUEBEC AGENTS
Ross & Greig, 412 St. James Street, Montreal, Que.

BRITISH COLUMBIA AGENTS
Robt. Hamilton & Co., Vancouver, B.C.

The Highest Head Ever Developed on a Large Scale

An Installation of Water Power Equipment Which has Undoubtedly Features of Interest for Canadian Hydraulic Engineers. The Development of Canadian Water Powers is Much in Evidence at the Present Time, and Information of What is Being Done in Other Countries in This Direction is More or Less Valuable in That Local Conditions and the Means of Tackling Them Have a Similarity on Many Grounds.

THERE was successfully started about two months ago, the Adamello Power Plant in Northern Italy, where a head of nearly 3,000 feet has been utilized. A general idea of the layout of the plant can be got from Fig. 1.

The Lago d'Arno is situated not far from the point where the frontiers of Italy, Switzerland, and Austria meet in the group of the Adamello Mountains. The Lago d'Arno, a typical Alp lake, is surrounded by rocky ground, running steep down, and leaving only a narrow outlet for the River Poja d'Arno. Here a most suitable site for erecting a dam at comparatively low cost was afforded to raise the water level by 66 feet to elevation 5,937 above sea-level. Also on account of the steep descent of the lake borders, it was possible to lower the water-level considerably, and the inlet of the pressure tunnel has been fixed at elevation 5,789. A further lowering of the water-level by 26 feet to elevation 5,763 is provided by a floating pumping installation; this having been found necessary in the case of scarcity of water, during severe winters. There is also gained the advantage of enabling the inspection of the whole of the intake, without having to shut the plant down for any considerable time.

Total Head Available.

As will be observed from Fig. 1, the total available head amounts to 4,637 feet, covering a horizontal distance of not more than five miles. There are not many places in the world where such high heads exist at a horizontal distance of only five miles, combined with every facility for cheap and efficient development.

The total storage capacity created by lowering the water level by a total of 174 feet amounts to 1,060 million cubic feet, representing a continuous flow of 140 c.f.s., of which at the present, only 70 c.f.s. are utilized. The work on the storage dam has recently been commenced, and only the storage capacity created by lowering the water-level (elevation 5,781 to elevation 5,763) is available at present. It was decided to divide the total available head into two stages, on account of the long horizontal distance in existence at elevation 2,900. The gross head utilized by the first stage development amounts therefore to 3,037 feet.

The total output at elevation 2,900 will, when the plant is fully developed, amount to about 37,000 B.H.P. For the present only 18,500 B.H.P. is being utilized. The development is carried out by the "Societa Generale Elettrica dell Adamello," of Milan, Italy, and the power generated is being transmitted to Milan for power and lighting purposes. The pressure tunnel is cut in the rock, no lining being necessary. The total length is 5,000 ft. At the lower end of the pressure tunnel, a shaft had to be worked to the surface, having a depth of 230 ft. This provision was required

Fig. 2.

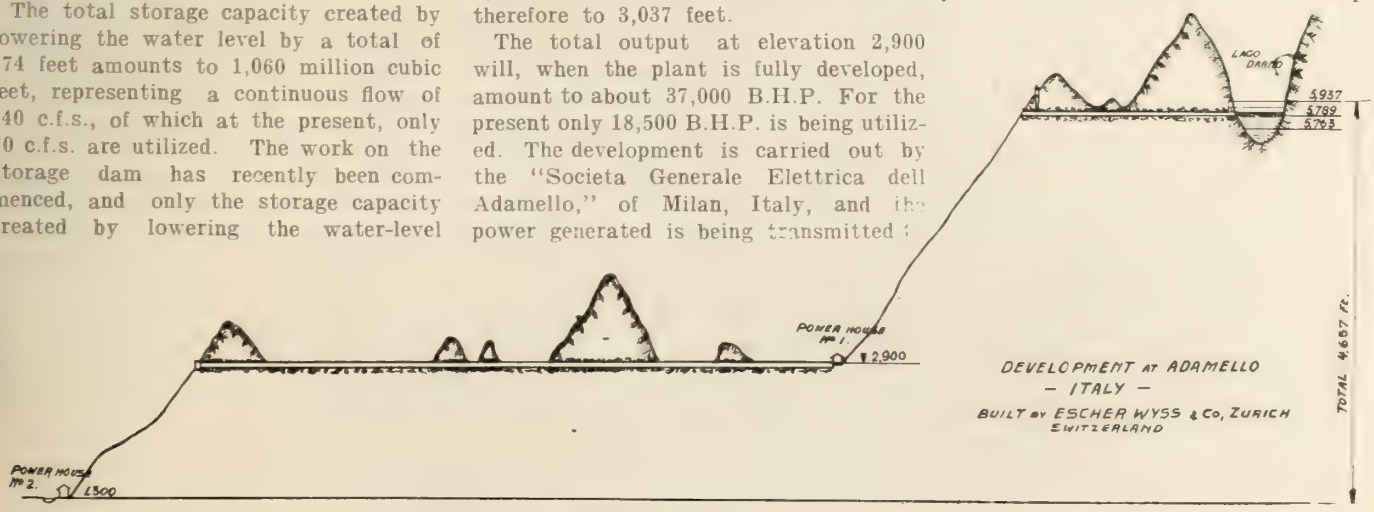


Fig. 1.—Geographical Location and General Layout.

to prevent water-shock in the pipe-line, when throwing off load. There is no actual intake; the pressure tunnel terminates in a steel pipe with branches and sluice gate valves, electrically operated from the power-house, for connecting up the various penstocks.

Design of Pipe Line.

The greatest care had to be observed in the design of the high pressure pipe-line, as the normal working pressure at the low end of tne pipes reached 1,320 lbs. per sq. inch. It was necessary to find the most economical and practical ratio between the speed of the water in the pipes. The stage to which the manufacture of high-pressure pipe-lines had attained, and the possibility of welding plates of great thickness, had also to be considered. After careful computation the speed was fixed at 6.5 ft. per second at the inlet, increasing to 13 ft. per second at the power-house. At the present two pipe lines, each carrying 35 c.f.s. are installed. In accordance with the above-mentioned velocity, the internal diameter starts with 31 in., gradually decreasing to 22 in. As usual the upper pipes are riveted together, having a wall thickness of ¼-in. to 9-16 inch, corresponding to a working stress of 8,500 per sq. inch. The lower part of the penstock consists of welded pipes, having a maximum thickness of 1¼ in., corresponding to a working stress of 11,500 lbs. per sq. inch. All pipes are in lengths of 20 ft. each, the upper pipes being riveted together circumferently on site. The welded pipes are partly fitted with spigot and socket, riveted together circumferentially on site, and partly fitted with loose flange joints, bolted together. A rubber ring is used as packing material, inserted in a tapered groove on the surface of the pipe-end.

The two penstocks are at the power-house connected one with the other by means of a cast-steel elbow, so that the water velocity will remain the same in both, and water hammer thereby be diminished. The distributing pipes run along the power-house wall, tee-pieces being inserted for connnecting up to the inlets of the turbines. All the welded pipes were officially tested in the contractors' shop to a pressure equal to 1.5 times working pressure, or maximum 2,000 lbs. per sq. inch before despatch. In working out the design of the turbines, naturally the greatest care had to be taken to ensure safe running under this unusually big head. The problem of eliminating any rise of pressure in the pipe-line, which easily might prove fatal, was thoroughly entered into, and the design of pressure regulating devices is a leading feature of this machinery.

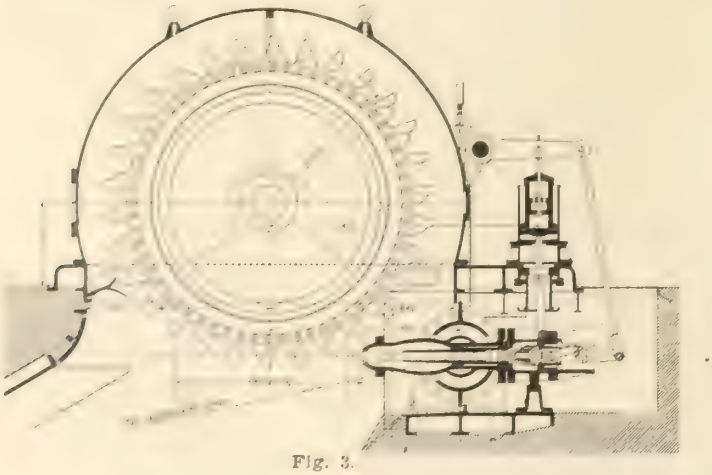


Fig. 3.

Pressure Regulating Devices.

There are different methods in existence, with the object of limiting any rise of pressure likely to occur in high pressure pipe lines, when the load is suddenly thrown off.

The device mostly employed is a relief valve (pressure regulator) connected rigidly to the gearing of the governor, so that when the governor shuts off the water supply, a relief valve is simultaneously opened, discharging into the tail race an equivalent quantity of water. An oil-dash pot is provided so that the valve gradually closes, and very little water is wasted.

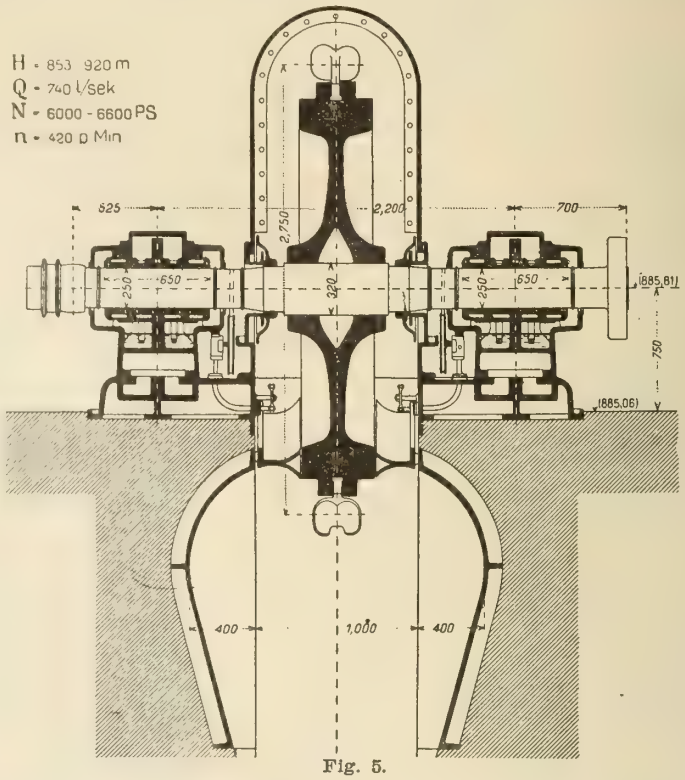


Fig. 5.

Another design provides a special device for diverting the water jet from the region of the bucket. Only in very few cases is a combined automatical control of the water supply and the movement of the water catcher ahopted, and consequently the waste of water is dependent on the care of the attendant, who in accordance with the load required, will have to control the water supply. Neither of the above means would, in this particular instance, have met the requirement. The high pressure would cause a relief valve to corrode quickly, and a water catcher would only for a short period, be able to stand the strain.

The adoption of a deflecting nozzle was therefore determined upon, the arrangement being as follows: Fig. 3. The oil pressure governor is rigidly connected to the needle, and through the medium of an oil-dash pot to the nozzle; this latter being arranged with the possibility of deflecting same. If a sudden throw off in load occurs, the governor gear will move quickly, and the needle which is rigidly connected thereto, will be moved correspondingly. This does not, however, mean any decrease of water supply. The sudden movement of the governor

gear also causes through the medium of the dashpot, the nozzle to deflect out of the range of the buckets, and this deflection of the nozzle compensates almost entirely the movement of the needle, so that the relative position of the needle and nozzle remain unaltered. Thus the water supply is unaltered, and there is no occasion for rise of pressure. The deflecting of the jet out of the range of the buckets, is practically instantaneous, and therefore the variation of speed is small ; in other words, the fly-wheel effect required to ensure good governing is reduced to a minimum. The dash-pot mentioned above, as transmitting the movement from the governor gear to the nozzle causes the nozzle to gradually move back from its deflected position to its original position ; the time required being adjustable, and fixed preferably by trial. While the nozzle goes back, the governor gear and the needle rigidly connected thereto, remain stationary. By this movement of the nozzle, the position of the needle in relation to the nozzle is altered ; the water supply being slowly (time being adjustable) cut off so as to finally correspond with the power required. As a sudden cutting off of the water supply is the cause of pressure rise, and as above mentioned, the quickness of this movement is adjustable, it will be understood that the rise of pressure practically may be limited as desired. When actually tested, January last, this design proved most efficient, the rise of pressure only reached some few per cent., maintaining the usual figures for variation of speed.

Highest Possible Efficiency Realized.

From the foregoing the importance of having a water-wheel equipment giving the highest possible efficiency is realized. As the storage capacity is limited, and on account of the big head, one gallon of water in continuous flow is equal to an increased output of 250 B.H.P. If therefore, the efficiency of the equipment could be increased beyond the usual figure of about 78 per cent., each per cent. would mean an increase of power supply of 180 B.H.P., or at the rate of $20 per horse-power a year, an increased income of $3,600 per cent. If this amount is capitalized, it appears that no outlay should be spared to secure water-wheels of the highest efficiency. The efficiency reached its maximum at about ¾ load : viz., 88 per cent., remaining practically constant from half to overload, 7,000 B.H.P. See Fig. 6.

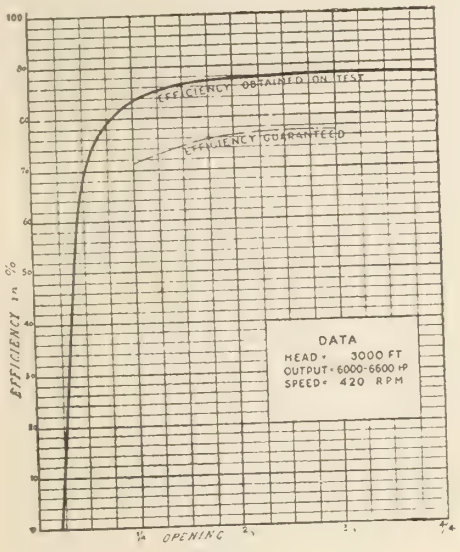


Fig. 6.

Each of the four installed units is designed for generating 6,608 B.H.P. maximum, running at 420 revolutions per minute. On account of the high efficiency, a maximum output of 7,200 B.H.P. was attained. The diameter of the jet is 3 in., the velocity of the water when discharging 27,000 ft. per minute, the pitch diameter of the runner-wheel is 9 ft. and the diameter of the shaft in the bearings 10 in. The buckets as well as needle and nozzle, are of specially prepared cast steel, highly resistant to high pressure water. The bearings are self-lubricating, by means of ordinary rings. The oil is taken from the surface of the oil-chamber forced through tubes into the runner-chamber. to be cooled, then back upon the shaft. The speed governor is of standard oil-pressure type ; the oil-pump, air vessels, pendulum controlling valve, etc., forming one unit, mounted on the bed-plate of the main turbine.

Fig. 2 gives a view of the whole of the plant, and Fig. 4 illustrates the compact appearance of the turbine and governor. Fig. 5 gives a sectional elevation of the main turbine from which all provisions made to conduct the water smoothly into the tail race may be seen. The first step has thus been taken in the development of the very highest heads, and as the success is undoubted, this development will be followed by others in countries where high-heads are available.

Escher Wyss & Co., Zurich, Switzerland, designed, manufactured and installed the hydro mechanical portion of this plant, and we are indebted to their chief engineer and Canadian representative, Thv. Heyerdahl, Lumsden Building, Toronto, for the illustrations and text of the article.

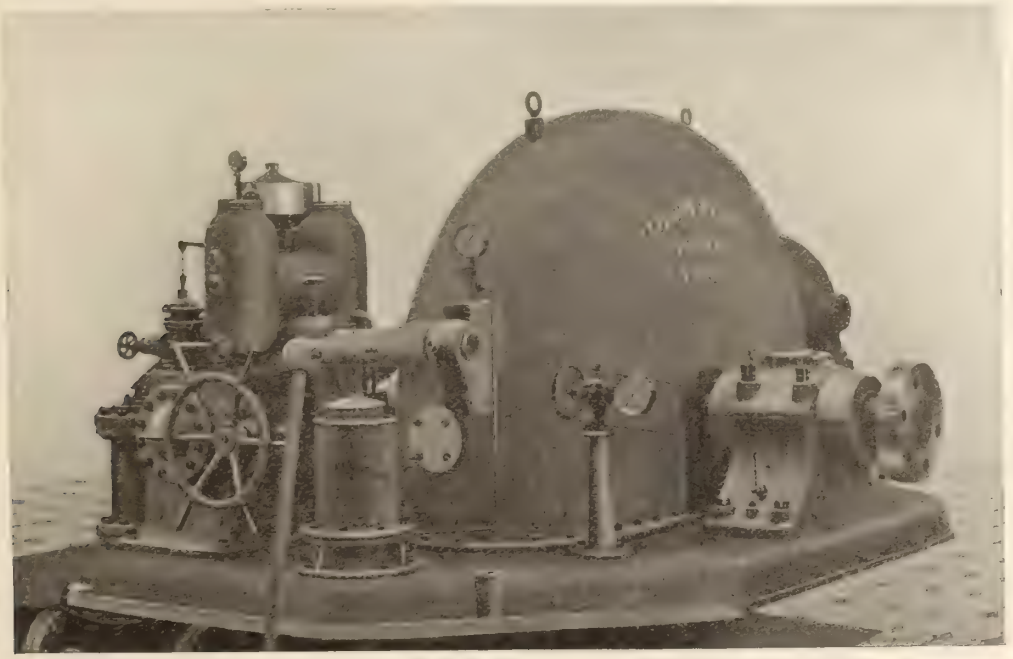


Fig. 4.

The Use of Gas Engines for Electrical Generator Drives

By A. S. Atkinson

A Discussion of the Factors Entering Into the Operation of a Combined Gas Producer and Gas Engine Driven Electrical Generating Plant; Data Obtained From Actual Experiences and Requirements of Attendants to Secure Successful and Economical Results.

IN electrical driving by gas power the engineer in charge has under his management two types of machines calling for more or less intimate knowledge of their respective requirements. An electrical engineer may know the secrets of his particular specialty, and the gas engineer may be equally well informed concerning his, but when gas engines are direct connected or belted to electrical generators, it is quite apparent that there must be a pretty good knowledge of both to ensure proper management. The increasing practice of using gas engines for driving electrical generators, so that current can be distributed throughout a large plant both for lighting purposes and operating machines, makes the demand for competent engineers who understand the primary principles and needs of both types of machines, a question of much importance. In the case of producer gas plants, the competency of operators is of still further importance. Trouble with producer plants in the past has been lack of skilled attendance. In the connecting up of electrical generators to gas engines and producers, skilled mechanics are a necessity.

Recently many producer plants have been installed for the generation of electrical power, and the service rendered has been extremely satisfactory where proper attention has been given to operation. This is the most economical and efficient method of generating electricity outside of water power, and even in this latter field, the producer comes pretty close to being a competitor. The advent of the steam turbine in the electric driving field gave a new impulse to the generation of electricity for shop and general use. The gas engine has proved its worth in this field with less of the trouble encountered in the development of the steam turbine.

The chief objections to the use of gas engines for electrical purposes was the lack of uniform angular velocity, uncertainty of action, and inability to carry heavy overloads. Improvements of recent date have removed these objections, hence the vigorous adoption of the gas engine for electrical driving. The gas engine to-day designed for electrical purposes carries a capacity of 50 per cent. overload, and where greater overload is required, such as railway operation and street lighting at certain hours of the day, storage batteries of large capacity are provided. For ordinary shop purposes the overload capacity of the gas engine whether operated on producer, natural or city gas is sufficient for all purposes, even where the load fluctuates violently.

Description of Producer Gas Plant.

A producer gas plant for electrical driving is well illustrated in the factory of the New York Standard Watch Company, Jersey City, where for over a year a 225 horse power suction gas producer has been furnishing power to a 140 horse power vertical gas engine, operating a 100 K.W.-D.C. generator, in addition to supplying gas for brazing and forging furnaces, driving pumps and fans direct. The electrical power generated lights the whole shop and operates a great number of small machines. There is one 100 k.w. and one 25 k.w. generator direct-connected to the gas engine. These generators are compound-wound, direct-current, and designed for 250 volts. The generators and motors are located so that a minimum of power is lost through operation, and the workmen at widely separated points in the building, always have their machines under perfect control. They are arranged with separate equipment of switch board connections for operation in parallel, giving large overload capacity in any particular part of the shop. The small generator furnishes power for the lesser machines, but was installed partly for purposes of overload in the main shop when needed. There are inter-connected busses and equalizers between the switchboard in the gas engine room and all parts of the building.

The reliability of this plant for generating electrical current is indicated by the fact that there has been no interruption of work during the past year or failure of lights and motors to perform all the duty demanded of them. In point of overload capacity both gas engines have made excellent showings. The larger engine has carried at times a load as high as 459 amperes, and the smaller one a maximum of 125 amperes. The average load carried on ordinary working days is about 300 amperes or 70 k.w. but ranges in winter when the lighting load is a maximum, from 400 amperes or 90 k.w., down to 275 amperes or 65 k.w. This violently fluctuating load is easily handled by the two generators. Loading in excess of the capacity of the larger unit is handled by connecting the smaller unit in parallel. It is proposed to enlarge the plant by adding another electrical generator, so that three units can then be connected in parallel, for future increase of load. It is expected that the present producer will supply sufficient power to operate this third additional unit, more especially if the gas now used for brazing is temporarily cut off.

Gas Engine Equipment and Design.

Experience with gas engines for electrical driving shows that the ability to adapt the machine to economical load bearing is merely a matter of equipment and design. Any irregularity in the speed, due to what is known as cyclical variation, is permissible and does not interfere with the proper maintenance of continuous speed in the generators. Automatic regulation of the speed of the fly-wheel of the gas engine is now easily obtained either by throttle governing, cut-off governing, varying the richness of the charge and throttling the gas, or by varying the richness of the charge and admitting the gas earlier or later during the suction stroke, although always cutting it off at the same period at the end of the suction stroke. In Europe gas driving for electrical purposes adopts generally the cut-off governing and throttling to a uniform mixture. The chief objection to the latter method is liability to increase in gas consumption as the load decreases; entailing negative work. The reduced pressure at the end of the compression stroke sometimes interferes with prompt

HYDRAULIC SECTION.

On account of our specially featuring two Hydraulic Articles in this present issue of "The Power House," the usual Hydraulic Section does not therefore appear. Our June Number will see it resumed, and contain among many other miscellaneous items of interest, an account of a prominent Canadian Water Power Development and Equipment; showing that our Dominion is keeping pace in this field, by adopting the most modern appliances and scientific principles available.

ignition and even leads to reversal of stresses in the moving parts. By cut-off governing as used in European electrical plants, the operation is considered satisfactory when the engines are run at moderate speeds. There is little loss from negative work, and if the engine is working on heavy or medium loads, the regulation is simple. When working on light loads, the gas valve remains closed so that regulation is partly by small charges and partly by cutout impulses, avoiding heavy consumption on light loads.

The operation of continuous-current generators by gas engines, has reached a point of simplicity and reliability that makes this form of power production of great advantage, but driving alternate-current dynamos in parallel, requires special design and installation. The steadiness required for driving alternators, differs materially from that demanded for continuous-current machines.

Gas Engines and Alternating Current.

For alternating machine driving, multiple cylinder engines are used, those giving two impulses per revolution are best suited for moderate powers, and for larger powers two such should be combined, having their cranks at right angles. In the best designed plants the fly wheel travels at a speed varying between mean and maximum of only 0.312 per cent. which makes an excess angular irregularity of only 0.14, and is so slight a deviation that the synchronizing efforts of the alternators themselves practically makes up the difference. They counteract any irregularity in working, and make the operation smooth and regular.

In designing gas driven electrical machines of this type, considerable care must be exercised in the relative positions of the cranks, flywheels and alternators. Where possible it is desirable to build up the armature of the alternator on the fly-wheel itself, or at least directly coupled to it without passing the strain through separate keys on the shaft. Where four cranks are used in vertical four-cylinder engines, the practice is usually this method of winding, with only one flywheel at the same end as the alternator. With a flywheel at each end, there is some chance of vibratory strains starting in the crank shaft, and which might prove serious enough to fracture it under heavy working loads.

Combination Units.

A few years ago a number of combination units was the method adopted. A single plant was equipped with gas engines and steam turbines, the object being to secure greater efficiency and wider variation of load. A number of plants are still thus equipped, and the steam engine is held in reserve for breakdown or for auxiliary purposes. Few, however, are built to-day, and many of the old ones are having the steam unit replaced by gas engines.

In such combinations, it was figured that the steam-turbine unit could easily for a few seconds take care of a 100 per cent. overload. Experience has shown that the load fluctuation is rarely, if ever, in the ordinary plant, more than 25 per cent. with a maximum of 50 per cent. for a few seconds. This the gas engine can take care of without interruption, or undue strain upon the moving parts. The combination units of steam and gas are not considered good engineering practice to-day, and very few adopt them, except where a steam engine is already installed.

Naturally in plants where a steam turbine is in operation, it becomes a question of policy whether to remove it in favor of gas engines; but the change from steam to gas is steadily progressing in plants where the old engines need replacing by new ones.

A man who signs himself as W. Keppel White is taking collections, renewal and new subscriptions, for the MacLean publications in the Maritime Provinces, without any authority. The assistance of any subscriber in locating this man will be appreciated.

EXPERIENCES OF AN ENGINEER

By J. C. T.

I am sure it would be very interesting reading, if some of our engineers would relate a few of their early experiences; not necessarily about the large plants (or the small ones for that matter) they have handled, but about the various trifles that help to keep an engineer on the jump.

A Choked Pump.

About the first job I had was firing three Lancashire boilers along with another fireman. The boilers were of about 500 h.p. each, hand fired, using hard coke screenings. On the same main steam line were four more boilers of equal size; these were fired by the waste gases from a line of coke ovens. One man handled this battery, as he had no firing to do. About 9 o'clock, one night, he came and asked us to turn some of the feed water from our pump into his boilers, because his pump refused to work. He had already wasted a lot of time trying to get it going, but had failed. and in the meantime the water in his boilers was showing only about one inch in the glass. Some tall hustling was needed, as our pump was too small even to feed our seven boilers all the time. I went back with him, we removed the valve covers and discovered a large handful of stone pebbles under the suction valves. This would not let them close, and was the cause of the trouble. We replaced the covers, started the pump and then took a peep at the water gauges. In three of the four boilers, the water was just going out of sight, and the fourth showed about a quarter of an inch. We saved the situation, however, so all breathed freely once more. I put in two and a half years firing these boilers, and at the end of that time I had learned something about them and pumps.

Burst Gauge Glass—Wasting Steam?

Hearing from a friend of mine that a small firm required an engineer, I applied for and got the position. I felt great. This was the first plant in which I had actual charge of an engine and boiler, and although only about 50 horse-power, it was certainly a proud moment for me when I got the position. The plant consisted of a Cornish boiler and an old-fashioned slide-valve engine with throttle governor. The engine was located in a dark dismal hole where it could scarcely be seen, but I used to polish and rub the poor old thing every old time I got the chance. The connecting and eccentric rods certainly shone like a mirror. One morning I was opening the valves of the water gauge and when just about full open, the glass burst. This was my first experience with a broken water gauge, and the noise sounded to me something fearful. The water gauge was level with my face. I was startled to say the least, and got my hands well scalded before the valves were closed again. Anyway, I got a new glass, and everything went fine until one Monday morning the manager came in very early. I was just starting the engine, and quite naturally had the cylinder drains open to let the condensation out. He politely informed me that I was wasting steam. Needless to say I informed him that he was mistaken, and no more was said.

In this particular plant, I was supposed to make myself useful around the place doing odd jobs, and after about 12 months there, an engineer's job did not appear to be so rosy as I had pictured it in my younger days. I left and got a position in a steam laundry. Nothing particular happened, except that there was not enough draft to keep up steam, no lubricator on the engine and the firm would not buy one. There was no feed water heater, and water was pumped into the boiler ice cold. Last but not least, I was expected to help scrub overalls in my spare time, but strange to say, I never had any spare time.

Broken Wrench On Blow-Off Valve.

My next job was a plant of about 100 horse-power, consisting of a return

tubular boiler and a Brown automatic engine. To get to the blow-off valve there was a passage up one side of the boiler about two feet wide. There was an ordinary two-inch plug valve on the blow-off pipe, and when the valve was open, the water simply blew down the passage and all over the boiler room. One morning I went to blow down the boiler as usual, and had got the valve about half way open, when the wrench broke in two. I was in a fix. I had to pass that stream of boiling water somehow, get another wrench, go back the same way, and close the valve. I did it all right, but I don't know yet how I got past that water without being scalded.

Broken Pump Valve Spindle.

The morning I took charge of this plant I was told that the pump would not work. There was not an ounce of steam, and about one inch of water in the glass. Fortunately the boiler feed line was connected with the city pressure, so I put some water in the boiler by it and lit the fires. Whilst steam was rising, I took off the valve cover of the pump which was duplex double acting, and found the thread stripped on one of the valve spindles. A new one was put in, and the pump went away all right. These are a few of the small trifles that go to make up the light of the engineer. They put a man on his mettle and if he profits by them, make him wiser and better.

ROPE TRANSMISSION.

By Dipper.

The rope drive as a power transmission factor has not lost any of its hold in the estimation of those who have made a careful study of its operation. Aside from the question of superlative merit of either the English or American systems, there is undoubtedly a field of usefulness in which it equals and possibly excels other methods.

It occurs to us that conditions and circumstances enter more largely into the determination of the various details constituting a rope drive than have to be accounted in that of a belt drive, therefore the following notes and observations on rope drive practice may be found interesting and useful.

Manila and cotton are the materials generally used for rope purposes and may be constructed of 3 or 4 strands. The rope diameters in practice vary from 1 to 1¾ inches, although those below 1½ inches are somewhat uncommon. From investigation it has been computed that the safe and economical working strain for a 1 inch diameter rope is 200 pounds, with equivalent for other sizes. Rope wear is both internal and external, caused in the former by the movement of the fibres on each other, and in the latter by slippage and wedging in the pulley grooves. This wear, of course, is normal and is dependent on the speed of drive.

As in belt drives the advantage lies with large diameter pulleys, the tendency being to less internal wear, due to fibre sliding decrease, with diameter increase. Care should be taken to have the grooves ground out smooth and of unbroken surface, so as to obviate unnecessary wear or tearing of the external surface of the rope. The groove angle may be 45 to 60 degrees.

Rope wear is independent of pulley distance apart, because it takes place on the pulleys only; at the same time distance is a factor in first cost.

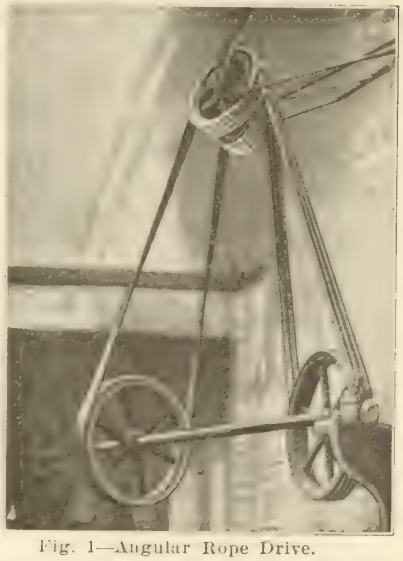


Fig. 1—Angular Rope Drive.

Experience goes to show that 80 feet per second is the speed at which the maximum horse power is attainable; speeds beyond this having the horse power output reduced by centrifugal tension. Cotton ropes require less lubrication than do Manila ropes.

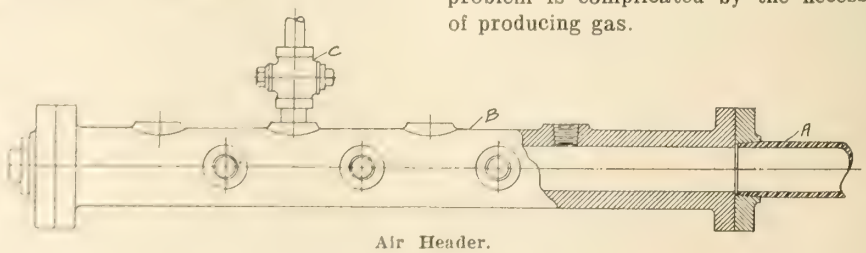
Rope driving is applicable and works satsifactorily in cases of indirect as well as direct requirement; the accompanying sketch showing an angle drive adaptation.

We are indebted to Jones & Glassco, Montreal, agents for the Kenyon Patent Transmission Rope, for supplying us with cut of angle drive accompanying this article.

AIR HEADER.

The accompanying cut shows a convenient form of header for use in distributing compressed air from air mains, where the number of tools at any particular spot is more than two or three. This header permits of eight lines of hose being taken off from the one spot, and is a device found very convenient in the shop and yards of the Collingwood Shipbuilding Co., Collingwood, Ont., especially when constructing the boat on the ways, as a multitude of pneumatic hammers, and drills are in use.

Pipe A is connected by a T to the air main. The header itself, B, is a cast iron body with two sets of holes at right angles, staggered, thus facilitating hose connections. From each of these eight bosses on the header, the hose pipes lead out, with an independent valve, C, on each. The pipe A may be given a valve as well, permitting the whole head being shut off.



Air Header.

COMBINED STEAM AND GAS ENGINES.

In an exceedingly interesting paper presented to the Manchester Association of Engineers recently, Mr. Chorlton, of Mather and Platt, engineers, Manchester, England, suggested that a considerable improvement in efficiency could still be obtained from internal combustion engines, and particularly those of large power, by utilizing the waste heat from the exhaust gases to generate steam in a suitable boiler, and which could be made to augment the power obtained from the explosion of the gas. In the case of a four-cylinder multiple engine, three cylinders would work with gas, and the fourth with steam.

The suggestion is a very attractive one, and will no doubt be taken up, as not only will it be possible to lessen the cost of manufacture of gas engines by reducing compression pressures and thereby maximum explosion pressures, in order that such utilization of waste heat be better carried out; but the steam cylinders would furnish a convenient means for starting or reversing in marine work, while providing a means for the gas engine to take a considerable overload.

Whether this combination of steam and gas engine will bring about an application of internal combustion engines for marine work in the near future remains to be seen. Unfortunately, the problem is complicated by the necessity of producing gas.

Mechanical Drawing and Sketching for Engineers*

By B. P.

A Series of Progressive Lessons Designed to Familiarize Engineers With the Use of the Apparatus Necessary to Make Simple Drawings, to Encourage Them to Realize How Important a Factor it is of Their Equipment, as Well as Being a Profitable Pastime.

SET squares or triangles 30-60 degrees and 45 degrees, Fig. 7, with sides 8 and 6 inches long respectively, are suitable for most services and may be had in maple, cherry or mahogany with ebony edge, or in vulcanite, celluloid or other transparent composition. The latter are much used with open centres as illustrated.

The pencil has been already referred to, the only additional remark called for in its choice being its hexagon shape requirement. As such, it serves the double purpose of giving a better grip between the fingers when in use and has little inclination to roll off the sloped drawing board when not in use.

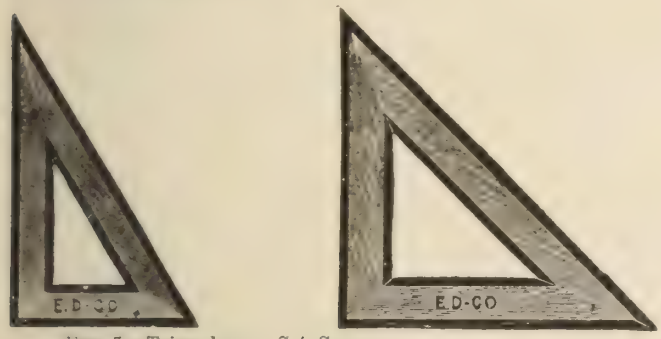


Fig. 7.—Triangles or Set Squares.

The pencil should be sharpened to a chisel point, Fig. 8, by means of which in the operation of drawing a straight line, the edge of the lead is kept close against the edge of the tee square or triangle.

Horizontal lines should be drawn from left to right and vertical lines from bottom to top of sheet. The tee square head should be held firmly against the board by the left hand and with the thumb pressure exerted on the blade as shown Fig. 9. Tne pencil also should be held firmly and vertically in the right hand, with the forearm and elbow kept well up from the drawing.

A very great help in keeping the otherwise unsupported pencil arm steady and ensuring against wavy lines, is to allow the little finger nail surface to touch the tee square lightly and allow it to slide along concurrently with the penciling of the line. The arm movement in the drawing of straight lines should be as much as possible from the elbow.

Up to the present only the apparatus for producing straight lines has been considered. Before passing to that pertaining to circles, parts of circles and curves, attention may be directed to pencil rubbers or erasers for lines drawn in error or of excess length. Fig. 10 illustrates such an eraser, which should consist of soft fine grained rubber and be free from sand, glass or dirt, all of which tend to break or glaze the surface of the drawing sheet.

Fig. 8.—Drawing Pencil Points.

Compasses for drawing circles and parts of circles, vary in style, size, quality, purpose and price.

Those used for drawing large circles of varying diameter are generally 6 inches long. Such a set, Fig. 11, in addition to the needle and pencil points, includes a pen point and lengthening bar for circles in excess of those attainable by the self-contained instrument.

Small circles of varying diameter, and forming by far the major portion of compass work in the preparation of mechanical drawings, are best taken care of by the bow pen and pencil instruments. They are more conveniently manipulated, being lighter than the others and only 3½ to 4 inches long. Each tool as will be noted from the illustration Fig. 12, is complete in itself.

Fig. 11.

Spring bow compasses Fig. 13 are usually about 3 inches long and as their construction shows, are capable of accurate adjustment. They are most suitable in circumstances where a large number of circles of equal diameter are required.

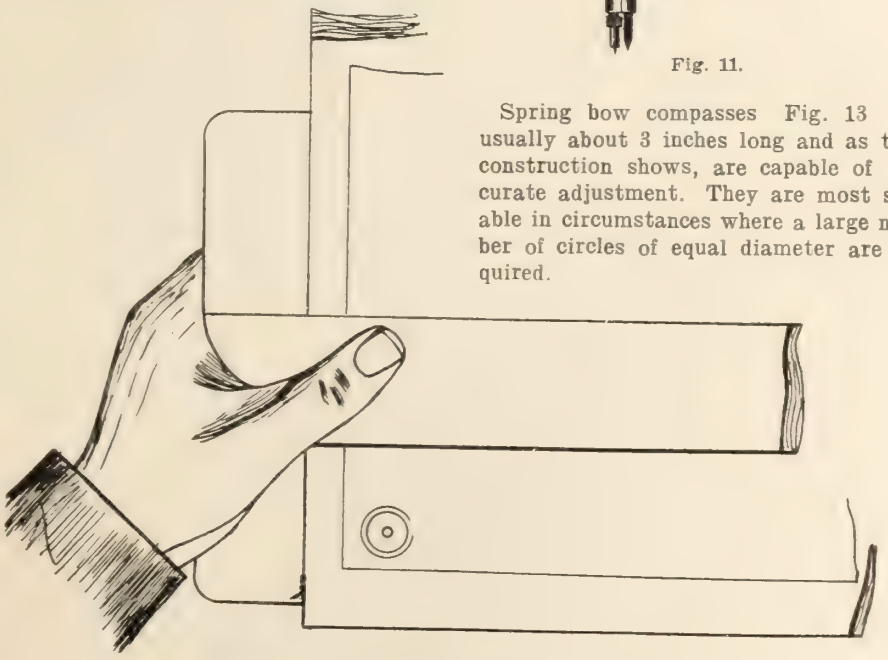


Fig. 9.—Application of T Square to Drawing Board.

*Third of a series of an Instruction Course. A lesson will be given each month.

The head joint of the two sets first described is an important feature to be attended to in making a selection for purchase. Double joints ensuring good lasting wearing surfaces should be their

Fig. 10.

constructional detail. The needle, pen and pencil arms at the junction to the body should be similarly equipped.

The material of compasses generally,

Fig. 12.

consists of German silver and good quality steel.

In purchasing instruments, those of the highest grade should be selected, consistent of course with one's purse, if satisfactory work is to be comfortably

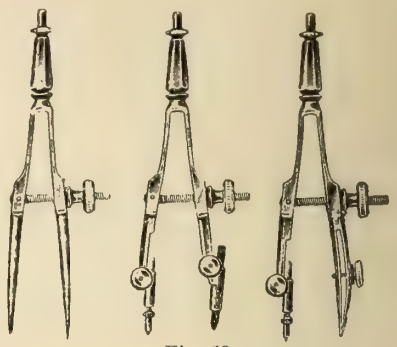


Fig. 13.

achieved and usefulness of tools is to be guaranteed for 10 or 15 years under constant daily service.

The pencil for your compasses should be one grade softer than that of your drawing pencil.

Series of Practical Questions and Answers for Engineers

By A. E. B.

Every Care is Being Taken to Include Only Pertinent Practical Questions, and Give Same, Direct Reliable Answers. Catch Questions will be Avoided. The Knowledge of Simple Addition, Subtraction, Multiplication and Division of Decimals, Will be Found a Most Useful Companion Study, and Should Not be Overlooked.

70—Q. What is meant by indicated horse power, when referring to a reciprocating steam engine?

A. It means the power actually developed in the engine cylinder as a result of the action of the steam pressure on the piston.

71—Q. What is meant by brake horse power when referring to a steam engine or other prime mover?

A. By brake horse power we mean the power which the shaft transmits. It is less than the indicated power by the amount due to friction which the engine has to overcome in moving its own mechanism.

72—Q. An engine cylinder 10 inches diameter by 10 inches stroke, running 200 revolutions per minute shows by an indicator diagram taken from it, a mean or average pressure of 60 pounds per sq. inch on the piston throughout its stroke. What would be the indicated horse power of the engine?

A. The indicated horse power is obtained by multiplying twice the stroke in feet, the mean pressure, the cylinder area and the revolutions per minute together, and dividing by 33,000. Thus:

$$\frac{\text{[illegible]} \times 78 \times 200}{\text{[illegible]}} = 47.58 \text{ indicated horse power.}$$

The multiplier 2 is used because there are two strokes in each revolution in a double acting engine.

73—Q. A direct acting steam pump discharges 100 Imperial gallons of water a minute against a 50-foot head of water; what horse power must be developed at the steam end of the pump, if the efficiency is 70 per cent.?

A. Multiply gallons of water by 10 to bring them to pounds, there being 10 pounds of water in one Imperial gallon. Multiply the result by 50, which will give the number of foot-pounds of work necessary to be done. This latter divided by 33,000 foot-pounds the horse power unit, will give the horse power required. The question states that the efficiency of the pump is only 70 per cent., therefore the actual horse power required, needs increasing proportionately. The amount already calculated, should there fore be multiplied by 100 and divided by 70. Stated in figure form, we have

$$\frac{100 \times 10 \times 50}{33{,}000} \times \frac{100}{70} = 2.16 \text{ horse power.}$$

74.—Q. What area steam pipe should be provided for an engine with cylinder 10 inches in diameter and a 24-inch stroke, making 180 revolutions per minute, providing 8,000 feet a minute is the average velocity of steam permitted in the steam pipe?

A. Find the area of the cylinder bore by squaring the diameter and multiplying by .7854. Find the piston speed by multiplying twice the stroke in feet by the revolutions per minute. Multiply the cylinder area and the piston speed together, and divide the answer by the permissible velocity of steam in the steam pipe. Stated in figure form, we have

$$\frac{10 \times 10 \times .7854 \times 2 \times 2 \times 180}{8{,}000} = 7.08 \text{ sq. inches.}$$

The diameter of the steam pipe is got by dividing the area already found by .7854, and extracting the square root of the answer. Stated in figure form, we have

$$\sqrt{\frac{7.0686}{.7854}} = 3 \text{ inches.}$$

In getting the size of the exhaust pipe, follow exactly the same procedure, only use 4,000 as the permissible velocity instead of 8,000.

75—Q. Do cylinder head and shaft coupling bolts carry the strain at the same part, and are they each subject to a like strain?

A. The answer is no in both cases. The bolts of the cylinder head have to

carry the strain on their weakest section (the bottom of the thread), while shaft coupling bolts carry the strain on the bolt body section. Again, the former are subjected to a tensile strain, while the latter are under that of shearing. On account of shaft coupling bolts bearing a body strain, the threaded portion is generally of reduced diameter.

76-Q. What direction would you move the eccentric on the shaft of a single cylinder slide valve engine, in order to make the cut-off earlier, and what change would the earlier cut-off make necessary on the lap of the valve?

A. An earlier cut-off requires the eccentric shifted round further on the shaft, ahead of the crank, and calls for additional lap on the slide valve.

77-Q In a 3-cylinder triple expansion engine of 200 I.H.P. driving a generator, and exhausting into a condenser, it was found by taking indicator cards that the horse power was not equally divided among the 3 cylinders, high, intermediate and low. The high pressure cylinder was doing much in excess of and the low pressure cylinder much under its intended share. What was done to remedy the trouble?

A. The cut-off on the high pressure cylinder was made later, thereby preventing the steam being expanded down as low as before, and enabling the low pressure cylinder to have sufficient pressure to do its own full share of the required work. The h.p, eccentric in this case was turned back in the direction of the crank, and less lap given the valve.

Explanation of Principles Involved in Answers to Questions

By Pedestal

The Bolstering up of Oneself With the Memorizing of a Series of "Don'ts," With Bald Knowledge Given of What You Should do, and the Cramming of Your Head With "Kinks," Will be of Little Service in Enabling You to "Hold Down" a Position, if You Have Neglected to Add Intelligence to Your Knowledge. Many a Child Can Repeat the Alphabet, but Cannot Distinguish One Letter From Another. In This Series we Aim to Help You.

EXPANSIVE USE OF STEAM.

The table of calculations and diagram forming the main portion of this article, although theoretical, serve to show the advantage gained in using steam expansively in an engine cylinder. We use the word theoretical, only so far as it applies to loss of mern pressure from causes not directly due to the principle of expansion. An example will make our meaning perhaps somewhat clearer.

Referring to the table it will be noted that steam is cut off at ¼ stroke, and the resulting mean pressure is 59.7 lbs. This is theoretical, because in actual practice only some 70 to 80 per cent. of the amount is obtainable, due to cylinder clearance, condensation, etc.

Assuming boiler pressure steam to be carried throughout the whole stroke, we would have a mean pressure of 100 pounds; theoretical as in the previous case with respect to amount and cause compared with the practical. It is, therefore in order to make a comparison between the theoretical mean pressure got by cutting off at ¼ stroke and carrying steam all the way.

Cutting off at ¼ stroke, we only take one-fourth of the cylinder volume of steam from the boiler each stroke, and get a mean pressure of 59.7 pounds. Carrying steam throughout the stroke, we take the whole cylinder volume of steam from the boiler each stroke, or four times as much as in the former case, and get in return a mean pressure of 100 pounds, or only 40 per cent. in excess of the other. Put concisely, using only a fourth of the quantity of steam each stroke, we get considerably more than half of the mean or average pressure; a gain in economy because the mean pressure is not in proportion to the quantity of steam used, but largely in excess of it. If it were a direct proportion, then cutting off at ¼ stroke would mean an average pressure of 25 pounds.

It is this principle which underlies compound, triple and quadruple expansion engine design, and proves high pressure steam economical as regards consumption. Again, less steam taken from the boiler, means less steam to be generated per stroke, which naturally requires less coal; and less coal calls for less cash outlay.

Construction of Diagram.

The diagram may be drawn to any height or length; the former being represented by so many pounds per inch of heights, and the latter divided into a requisite number of equal parts (usually ten), with its whole length corresponding to the engine stroke on a reduced scale. The expansion curve is found by marking off the pressures from the table on their proper ordinates.

Steam pressure 100 lbs. per sq. inch. Cut off at ¼ stroke.

To find curve of expansion by Boyle's Law, and the mean pressure of diagram.

Constant = p V.

" = 100 × ¼.

" = 25.

At 0, p . . . . . 100 lbs.

At 1, p . . . . . 100 lbs.

At 2, p . . . . . 100 lbs.

At 3, $p = \frac{\text{constant}}{\sqrt{\ }} = \frac{25}{.3} = 83.3$ lbs.

At 4, $p = \text{"} = \frac{25}{.4} = 62.5$ lbs

$\text{"} = \frac{25}{\ } = 50$ lbs.

At 6, p =

At 7, $p = \text{"} = \frac{25}{.6} = 35.7$ lbs.

At 8, $p = \text{"} = \frac{25}{.7} = 31.25$ lbs.

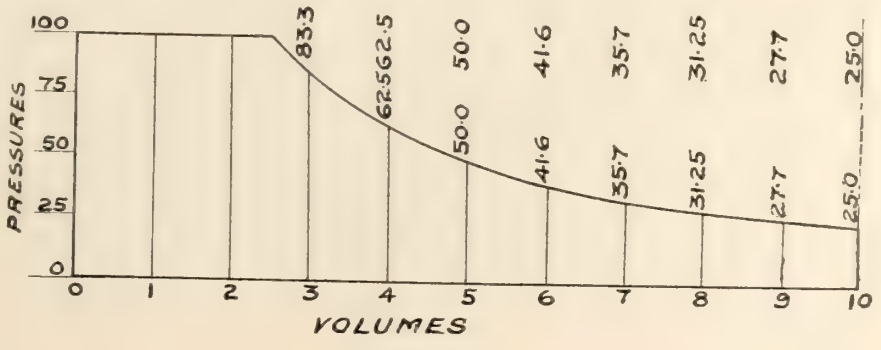
At 9, $p = \text{"} = \frac{25}{.8} = 27.7$ lbs.

At 10, $p = \text{"} = \frac{25}{.9} = 25$ lbs.

$\frac{25}{1}$

657.2 lbs.

Dividing by number of points we get an approximate mean pressure $= \frac{657.2}{11} = 59.7$ lbs.



Experiments on Water Discharge from Short Nozzles

By James Barr, B.Sc., and George Fax *

The Results of a Series of Tests Conducted at the Canada Foundry Co., Toronto, by George Fax, Have Been Taken up by James Barr, and Some Very Instructive Inferences Drawn Therefrom. While the Treatment of the Subject is Largely Mathematical, the Forceful Manner in Which it is Placed Before the Reader Simplifies any Difficulties That Might Otherwise Arise. The Mathematical Deductions Involved are Such as Arise in the Routine of Every Engineer who Attempts to Understand his Indicator Cards. In Addition, it Might be Said That the Advent of Water Wheels in Such Large Numbers Makes This Article Doubly Interesting as Adding to the Fund of Useful Hydraulic Information.

IF we have two variable quantities (x and y) connected by an equation of the form $y=Ax^n$, where A and n are numerical constants, we shall obtain a straight line if we plot a graph showing the logarithms of x and y; and from the position and slope of this line we can readily find the values of A and n.

This device is often of great practical service, not only in obtaining the values of A and n, but also in showing graphically the true relation between the varying quantities x and y, since the straight line can often be easily and accurately drawn.

For example, it is generally supposed that if D be the discharge from an orifice, and H the head or pressure at the orifice $D=A H^n$ where A and n have approximately constant values.

Deductions.

The accompanying table and diagram indicate the method of plotting the results and deducing the equations.

Let D be the discharge in Imperial gallons per minute and H the head or pressure at the nozzle in pds. per sq. inch. We see from the table that the values of D range from 37 to 364, and therefore log D varies from log 37 (=1.568) to log 364 (=2.561). The values of H range from 30 to 200, and therefore log H varies from log 30 (=1.477) to log 206 (=2.300).

We accordingly lay off a horizontal scale ranging from 1.5 to 2.6 and a vertical scale ranging from 1.4 to 2.3. We can now readily construct logarithmic scales of D and H. The log of 100 is 2, so the value 100 (of D or H) will appear opposite the point 2 in our scales. Similarly log 140=2.146 and the value 140 will, therefore, appear at the point 2.146 on our scales. In this way we find as many points as we deem sufficient to complete the scales. The experimental results are now plotted in the usual fashion. For instance, at a pressure of 100 lbs. per sq. inch, the ¾ in. nozzle was found to discharge 121 gallons per minute. Through the point 100 on the H scale we draw a horizontal line to meet a vertical line through the point 121 on the D scale, and the point of intersection P, is a point on the curve for the ¾ in. nozzle.

When all the points are plotted the nearest straight lines are drawn through them. The equation to each of the straight lines is deduced in the following way:

If $D=A H^n$

$\log D=\log A+n \log H$.

Log A is a constant quantity and n is in the diagram, the tangent of the angle which the line makes with the vertical axis. Considering point P

$$n=\frac{PQ}{QR}=\frac{7.8}{15.6}=\frac{1}{2};$$

log D=2.083; and H=2; therefore we have from the equation,

$\log D=\log A+n \log H$;

$2.083=\log A+\frac{1}{2}\times 2$; or

$\log A=1.083$; therefore

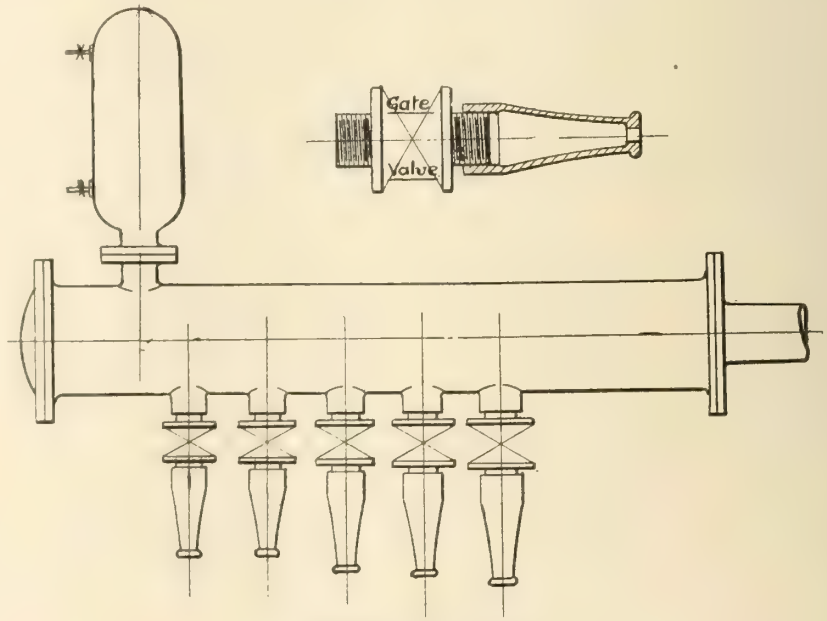
$A=12.1$.

Therefore, $D=12.1 H^{\frac{1}{2}}$ is, very approximately, the equation to the line.

In the equations given in the diagram, D is the discharge in Imperial gallons per minute, and H is the head at the orifice in pds. per sq. inch. The diagram also shows a scale of discharge in U. S. gallons per minute, and a scale of heads in feet of water. These are easily constructed as follows:

Taking N. Imp. gall.=(1.2N) U.S. gal.=M. U. S. gal., we have $\log M=\log 1.2+\log N=0.079+\log N$.

Therefore, if on our logarithmic scale of Imp. gallons we add to any value N a distance equal to 0.079 on our scale of logarithmis we shall arrive at the corresponding value M of U. S. gallons. For example, if N be 100 in Imp. gal., we see this number is at 2.0 on our original scale of logarithms, and opposite the reading 2.079 on the scale we find 120, which is the corresponding value M in U. S. gals. In other words, the U. S. gal. scale is obtained by moving the Imp. gal. scale forward through a distance 0.079 on our scale of logarithms. This has been done on the diagram by moving the scale this distance to the left, and placing it at the top of the diagram, to avoid confusion. It will be seen that 120 on the U. S. scale is vertically above 100 on the Imperial scale.



Apparatus Used in Test.

For any value of H, within the limits of the line, we can find D from this equation,

If H=166;

$D=12.1\sqrt{166}=12.1\times 12.9=156$,

which is the value given by the graph.

*Employed with the John Inglis Co. Toronto.

Similarly, if we take 1 lb. per sq. inch to be equivalent to a head of 2.31 feet of water, the 'feet' scale is obtained by lowering the lbs. per sq. inch scale through a distance=log 2.31 (i.e. 0.367) on the scale of logarithms.

Apparatus and Experiment.

The arrangement of the apparatus and the type of nozzle are shown in drawing. The nozzles were arranged in order of size in a row upon a 10 in. diam. horizontal pipe; the largest nozzle was towards the supply end, and an air vessel was provided at the closed end. Each nozzle was isolated by a gate valve with a clear bore of area not less than five times that of the nozzle, and the length of the parallel bore at the outlet of each nozzle was at least equal to the diameter of the nozzle.

The water was delivered to the 10 in. main by means of a plunger pump, and was measured by counting the revolutions of the pump; a correction being made for slip at each pressure. The slip was measured by shutting down the discharge valve and driving the pump to keep the required pressure constant. For example, if the pump was driven at 50 r.p.m. to maintain a pressure of 100 pds. per sq. inch during an experiment, and if when the discharge valve was closed the pump had to make one r.p.m. to keep the pressure at 100 pds. per sq. inch, then the slip was taken as 1 in 50 or 2 per cent. Precautions were taken to have fairly steady conditions before taking any readings.

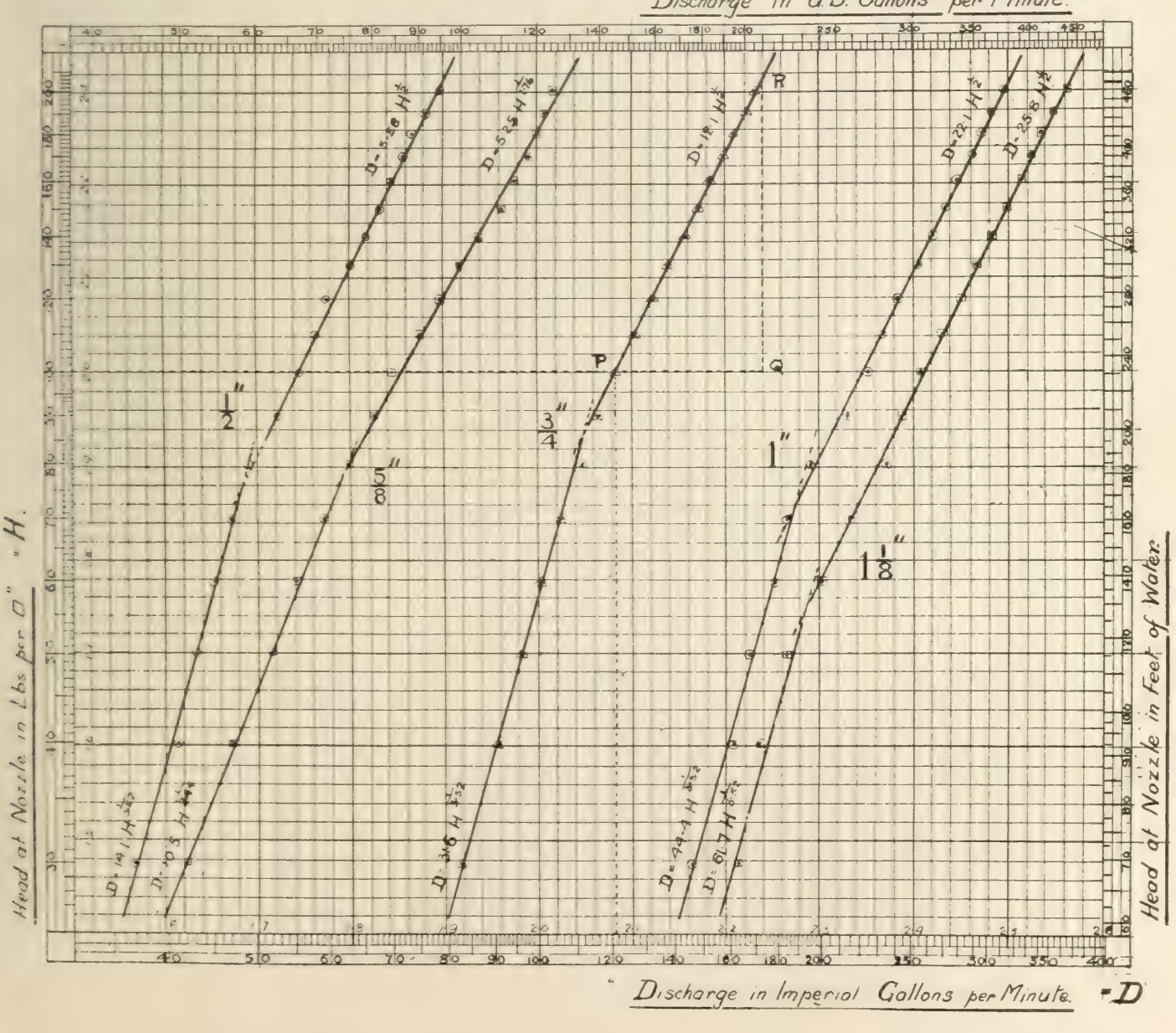
Conclusions.

All the nozzles were 'ringed,' i.e., they had an inside shoulder as shown in drawing, except the $\frac{5}{8}$ inch nozzle which was made from the $\frac{1}{2}$ inch pattern by boring away the ring, and which was therefore a smooth nozzle. This probably accounts for the fact of the discharge being relatively greater in the case of this nozzle, as the restriction of the flow would be less than in the others. The diagram shows this greater discharge very clearly by the altered slope of the curve.

That all the points should lie so nearly upon straight lines, and that these lines should be parallel for similar nozzles, would indicate that the method of measuring the discharge, adopted in making the experiments, was a reliable one.

It is at once evident from the diagram that each curve consists of two distinct portions, indicating two laws of resistance to the flow of the water. Up to the bend in the curve the resistance follows a definite law, but at the bend a velocity is reached at which the resistance becomes less, and it continues to be less, according to a new definite law, throughout the higher velocities.

It is supposed that this change in the law of resistance was due to the proximity of the gate valve to the orifice. The gate valve was equivalent to a sudden enlargement in the area of the pipe section and this would cause additional eddies and increase the resistance to the



flow at the lower velocities. It is however conceivable that a certain velocity would be reached at which the water would shoot past the valve so quickly that it would not be sensibly affected by the enlargement; the latter would cease to produce a noticeable increase in the resistance, and this would obtain for all higher velocities.

It is therefore concluded that the results given in the table and diagram admit of practical application only under circumstances where the conditions of experiment are approximately obtained with regard to the position of the nozzle with reference to the gate valve.

The object of the above experiments was the calibration of an apparatus for the testing of centrifugal pumps.

Discharge from short nozzles, in Imperial and U.S. gallons, per minute.

Size of nozzle	Pressure at nozzle—lbs. 30	40	50	60	70	80	90	100	110	1 Imp. equals
½-in.	44	49	51	54	57	59	64	68	70	1.2 U.S.
do	37	41	43	45	47	49	53	56	58	U.S.
⅝-in.	50	56	62	66	71	76	80	84	90	Imp
do	42	47	52	55	59	63	67	70	75	U.S.
¾-in.	100	110	115	121	127	135	139	145	153	Imp
do	83	91	96	101	106	112	116	121	127	U.S.
1-in	175	195	202	215	222	235	256	270	280	Imp
do	146	162	168	179	185	196	214	225	234	U.S.
1⅛-in	195	207	220	242	258	282	293	308	324	Imp
do	163	172	184	201	215	235	245	256	270	U.S.
										Imp

Size of nozzle.	Pressure at nozzle—lbs. 120	130	140	150	160	170	180	190	200	
½-in.	72	76	79	82	84	87	89	91	95	U.S.
do	60	63	66	68	70	72	74	76	79	Imp
⅝-in	95	100	105	110	114	118	120	123	125	U.S.
do.	79	83	87	92	95	98	100	102	104	Imp
¾-in	160	166	173	178	184	189	194	199	204	U.S.
do	133	138	144	148	153	158	162	166	170	Imp
1-in	290	305	315	325	335	347	355	363	375	U.S.
do	242	255	264	272	280	290	296	303	313	Imp
1⅛-in	338	351	364	377	391	401	411	423	437	U.S.
do	282	293	304	315	326	334	343	353	364	Imp

CONCRETE SYPHON UNDER HIGH HEAD.

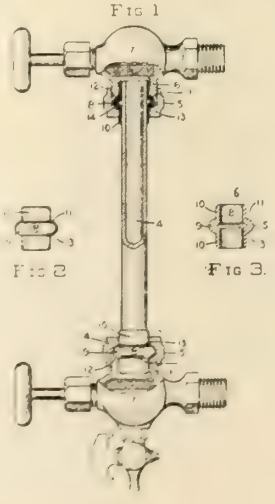
A reinforced concrete siphon has been built across the Albelda Valley, province of Huesca, Spain, which operates under a maximum head of 98½ feet. It is 2,378 feet long, 13.12 feet inside diameter, and has walls 7.87 inches thick, including an interior mortar coat of 0.6 inch. The reinforcement, which is varied from point to point in accordance with the head, consists of longitudinal round rods and circular T-irons, all tied by wire at intersections. Under the maximum head the T's measure approximately 2x2x¼ inch and are spaced about 3¾ inches apart on centres. The 124 longitudinal rods are each ½ inch in diameter. The concrete was mixed in proportions of 1:1¼:2½ and the inside mortar coat in proportions of 1:1. In order that any leakage might not disturb the foundation of the siphon it was laid in a bed of porous concrete which reached to the horizontal diameter and contained on one side a drainage channel. The upper half of the siphon was covered with loose stone, and the seepage was discharged to the channel through holes in the concrete cover over it, and from the other side of the siphon, through pipes in the foundation. This channel has an outlet to a drainage canal at its lowest point. After a year's service the leakage of the siphon is said to be scarcely perceptible.—Ex

STEAM CONSUMPTION TEST ON LARGE PARSONS TURBINE.

A steam consumption test on a large Parsons type turbine was recently carried out in the Dunston power station of the Newcastle-on-Tyne Electric Supply Company, and the results are referred to in a recent number of the Engineer. The normal output of the turbine is 6,250 kilowatts, or 9,000 horsepower. Steam consumptions of just over and under 12 lb. per kilowatt hour were obtained with steam at 190 lbs. pressure and about 170 deg. Fahr. of superheat. The vacuum was within 0.9 in. of the absolute zero. All the conditions were thus very favorable, but the results are none the less creditable, and, it is believed, constitute a record. An interesting feature is the comparatively small variation in the steam consumption between 4,256 kilowatts and 6,257 kilowatts load, the difference being only half a pound. This uniformity is undoubtedly mainly due to the high superheat; the same thing being noticeable in the case of reciprocating engines. The equivalent consumption at full load with 29.1 in. of vacuum and 190 deg. of superheat, is given as 11.8 lb. per kilowatt-hour.

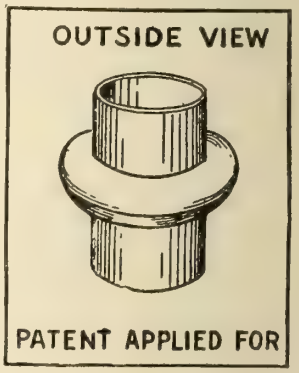
NEW GASKET FOR WATER GAUGE GLASSES.

A new type gasket for water gauge glasses has just come under our notice, the illustrations and descriptions of which are as follows: It is known by the trade name of the tip or lip bulb gasket,



and has among other attractive features the capability of easy adjustment and provision against gauge glass breakage from expansion. It is made in 6 sizes, those of ½ inch, ⅝ and ¾ inch being furnished with a wood plug to simplify application to the glass.

The arrangement of the gasket is shown in Fig. 1, while Figs. 2 and 3, show full and sectional views of the gasket alone. It will be noted that the gasket is globular in form, compresses



easily, and makes an effective water and steam tight joint.

The subject of water gauge glass gaskets is one peculiarly interesting to operating engineers and firemen, because of the delicacy of adjustment usually necessary, and the extreme liability to glass breakage, by the slightest inequality of same. More freedom of action is claimed for the operator by the use of this lip bulb gasket, on account of its construction and form tending to automatic accommodation when expansion is taking place.

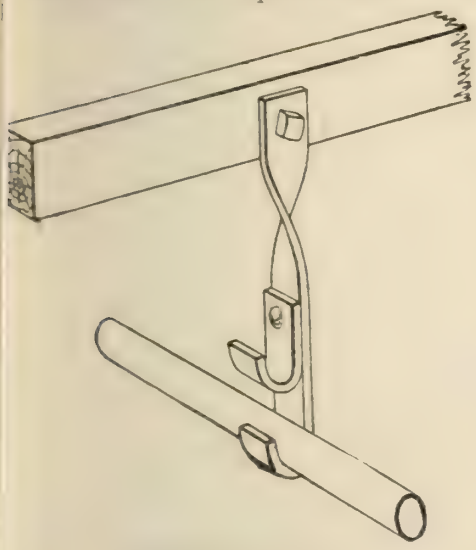
Gilbert and Hawkesworth are the patentees and manufacturers, while Alfred Hawkesworth and Sons Co., Ltd., Montreal, are the sole selling agents.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

SIMPLE PIPE HANGER.

The hanger shown in the sketch consists of two or more small hangers, riveted together in such a manner as to form hooks at the required distance from

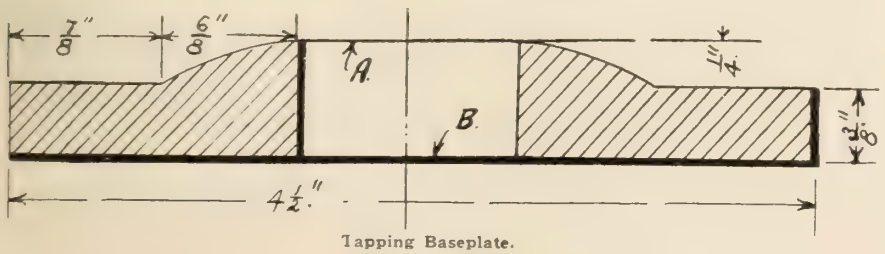


Simple Pipe Hanger.

each other, says an exchange. The hangers are made of wrought iron, about ½-inch thick and 2 inches wide. The iron can be heated first and bent around a pipe of the same diameter as that which is to be used. This will prevent the pipe from vibrating after it is hung. If the pipes are to run in opposite directions, or to the beams above them, the iron can be heated and twisted to the proper angle. The upper end is drilled to receive a ½ inch lag screw, by which the hanger is fastened to the beam.

HOW WOULD YOU TAP IT?

In a certain steam plant, a rail was being put around the wheel pits, and gave rise to a discussion, as to which side of the pillar base attached to the engine frame, the tap for making the pipe rail thread should enter. The hole in the base plate was 1¼ inches diameter and required increasing to 1½ inches to suit pipe. The views of fellow readers of "The Power House" are solicited. —S. H. S.



Tapping Baseplate.

SOME EASILY MADE REDUCING MOTIONS.

S. K. B.

This article is intended for the engineer who is beginning to use the indicator, and will give a brief description of a few home-made reducing motions that will give good results. Of course, a reducing wheel purchased from a reliable indicator manufacturer will give the best results with the least trouble, but there are times when a knowledge of easily made rigs may become very useful.

The "lazy tongs," Fig. 1, is a theoretically correct motion, and is much used with long stroke engines. It should be made of light, tough wood, the bars 1, 2, 3 and 4 being double; and the others placed between, to give stiffness. If to be used often, all joints should be bushed, and the bolts turned to fit, although for occasional use this is not necessary.

The joints in any case should be without lost motion, work freely, and be kept well oiled. A good way to fasten the end A is to attach it to an angle iron, held under one of the nuts on the cylinder head. Great care should be taken that the point where the cord winds on the indicator drum, and the points A, B and C are all in line and parallel with the guides, or in other words, horizontal. The end A can also be attached, in a horizontal position, to a stand erected on the floor opposite the centre of the guides, the cord being run over a pulley, in such a manner that it leaves the point B parallel with the guides. This is a good arrangement for strokes of four and five feet.

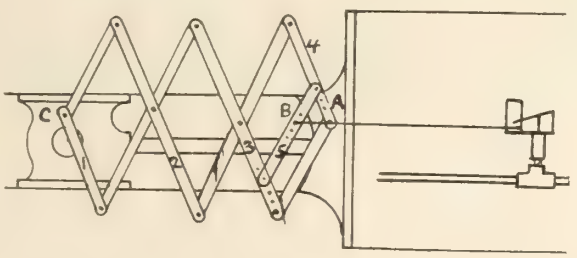


Fig. 1.

The bars 3 and 4 have a number of holes in them so that the position of the bar 5 can be adjusted for different strokes. The bar 5 also has several holes in it, in order that the pin B, to which the cord is hooped, can be kept in line with A and C, which is absolutely necessary, as otherwise it does not travel in a horizontal line and does not give a correct reduction.

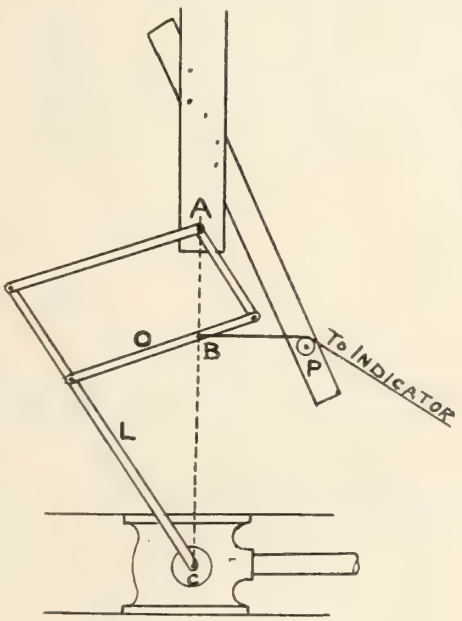


Fig. 2.

To set the point B for a given stroke and length of diagram, stretch the motion out until the distance from A to C is equal to the stroke and then set the bar 5 and pin B so that the distance from A to B is as near the desired length of card as possible.

The pantograph, Fig. 2, is another theoretically correct motion. The four bars being joined together forming a rectangle, the bar L being longer than the others, and fastened to the crosshead at C, while the corner A is fastened to some support that is ridged

Boiler Design, Construction, Operation, Repairing and Inspection *

By H. S. Jeffery

Repairing Boilers.

When applying a patch to a boiler the type of boiler has a marked bearing on the type of patch that should be applied; likewise how the patch should be applied. If the bottom of a tubular boiler

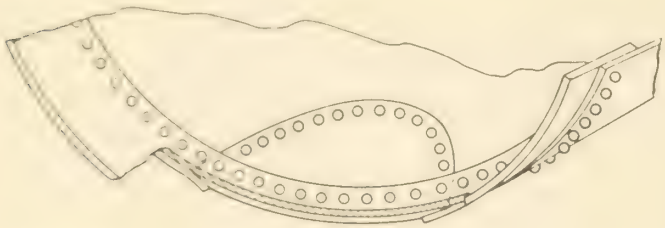


Fig. 27.

is defective and a small patch is to be applied adjoining the centre girth seam, a patch as shown in Fig. 27 should be applied. It is frequently called a horse-shoe patch. The illustration, Fig. 27, shows that having cut out the defective shell sheet, the girth seam rivets when replaced hold a portion of the patch in place. It is essential to scarf the plate at points A, Fig. 27, in order to cause no abrupt openings at the three thickness of plate.

If the shell plate is defective adjoining one of the flue heads and a patch, horse-

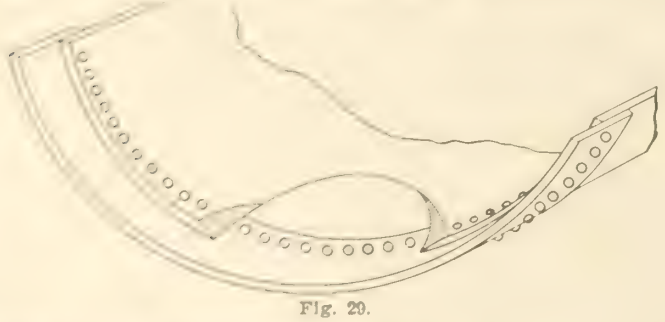


Fig. 29.

shoe style is applied, the corners A of the patch should be scarfed as described in the foregoing instance. This is illustrated in Fig. 28, this being the case whether the patch is applied to the large or the small course of the boiler.

The patch, Fig. 27, is an illustration of a patch applied to the large course of the tubular boiler. If the patch is to be applied to the small course of the boiler, the method is similar, except the shell sheet is scarfed instead of the patch. This is illustrated in Fig. 29, the points A being scarfed. If the sheet is not scarfed as indicated in Fig. 29, then the patch when applied would have an offset as indicated in Fig. 30 at the points A.

The object of the horse-shoe type of patch is to prevent placing in the longitudinal plane a single riveted joint Such a patch, and in fact every patch applied to the bottom of a tubular boiler should be riveted in place—never apply with patch bolts. The shell of a tubular boiler is a vessel, and, accordingly differs from the firebox of a locomotive boiler or the combustion chamber of a marine boiler, where a patch can be applied with patch bolts.

The shell of a tubular boiler when under steam pressure is under tension—that is, forces acting upon the shell tending to pull it apart. Now, with the furnace sheets of a locomotive type boiler, the chief consideration is to keep the plates from deformation, or bulging. For this reason staybolts are placed at given intervals, thus supporting the sheet to carry the load.

Fig. 31.

The firebox or the furnace sheets of locomotive, traction and other types of boilers, crack from staybolt hole to staybolt hole. The causes leading to the cracking are many. The punching of the staybolt holes frequently cracks or fractures the plate around the holes, this being especially true if the holes are punched with a dull punch and a large die.

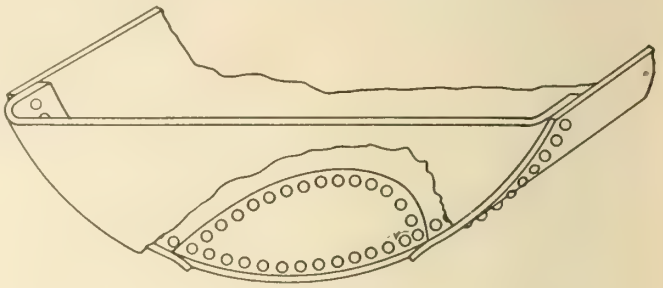


Fig. 28.

Punched holes make a rough and irregular hole in the plate as indicated in the illustration, Fig. 31. For this reason many authorities require that all rivet holes which are punched shall be punched one quarter inch or so smaller than the diameter of the rivet to be used and then reamed out.

While this practice is carried out by many in regards to rivet holes, it is not carried out extensively throughout the country in regards to staybolt holes. The common every day practice seems to be to punch the staybolt hole about one-eight inch less in diameter than the diameter of the staybolt—some punch the hole three-sixteenths less in diameter than the size of the staybolt.

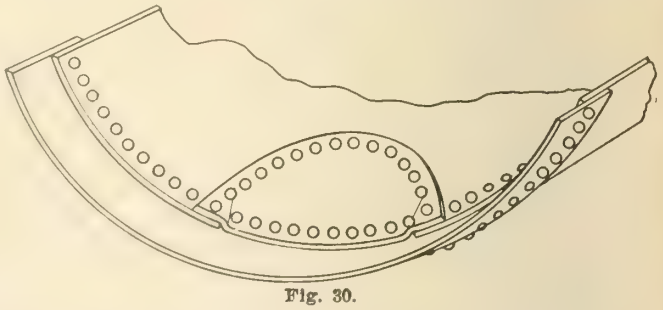


Fig. 30.

While the furnace sheets are usually light compared to other sheets of the boiler—and they are made thin to make easy transmission of the heat through the plate to the water within the boiler

the staybolt holes are nevertheless irregular if punched, though not so irregular as rivet holes in heavy plates.

The fracturing of the plate by punching permits a starting point from which the crack extends and many times extends from staybolt hole to staybolt hole. At the outset the crack may be repaired by placing in the sheet a small plug as indicated in Fig. 32. A small hole is drilled into the crack, after which the hole is tapped and a plug screwed in and then riveted and calked over. The number of plugs depends upon the length of the crack, and where more than one plug is required, it is the practice to install the plugs so that they overlap.

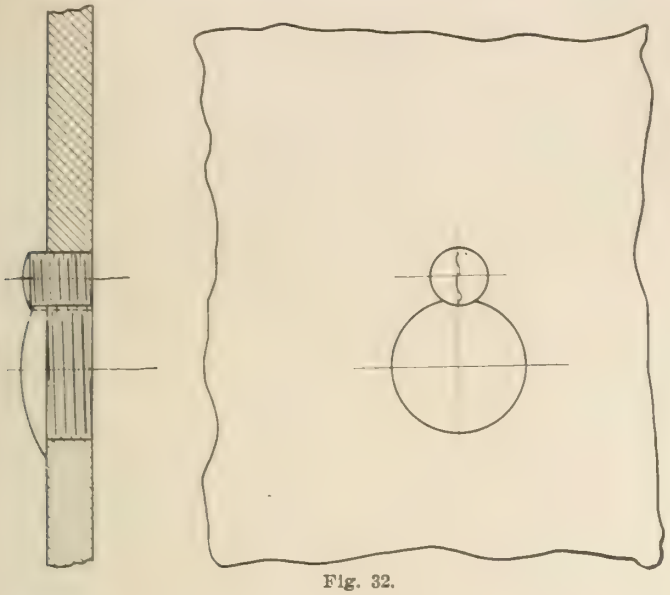


Fig. 32.

Thus if a crack one inch long is to be plugged, the first plug would be the plug A, Fig. 33, which would be placed at what was supposed to be the end of the crack, though this point is often hard to ascertain, for the crack may be of a character that it cannot be fully traced from the side or point from which the examination is made.

After plug A is installed, then plug B is installed, after which plug C is installed. It will be seen that plug C overlaps plugs A and B, and after all the plugs are installed they are riveted and calked over to form a ridge, the whole process being known as SEWING UP A CRACK. The plugs are usually about three-eighths inch in diameter and threaded twelve threads per inch.

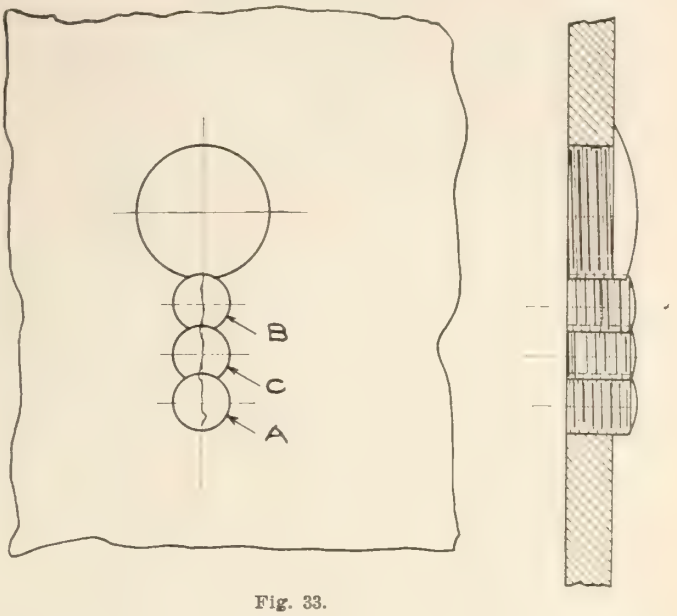


Fig. 33.

Power Plant Troubles, Happenings and Improvements

By Blackrock

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

STEAM-POWER AND GAS-POWER.

The late Sir Frederick Bramwell once prophesied, that in view of the high fuel economy realisable with internal-combustion engines, it was only a matter of a relatively short time, before the steam engine would be relegated to a museum of antiquities.

In certain special fields, no doubt, the internal-combustion engine has steadily gained ground on its older-established rival. It soon became popular for power installations of the smaller class, but here it met its competitor on ground particularly favorable to itself. The smaller class of steam engine was undoubtedly pretty reliable, but its best friends were never disposed to deny its voracity, considered in the light of its "steam-eating" capabilities. Hence even the high cost of lighting gas, did not suffice to check an ever-increasing sale of gas-engines to small users of power.

Gas Producers.

The introduction of the producer, and in particular of the suction-producer, has, of course, still further popularised the smaller and medium-sized classes of internal-combustion engines. Really large gas-engines on the whole however, have been less satisfactory. The best results have been obtained when they have been run on blast-furnace gas, which has a calorific value of but 90 to 95 British thermal units per cubic foot. Using this special fuel, these engines may now, no doubt, be considered to be a commercial success; but it is highly doubtful whether the visions of power plants generating 20,000 to 50,000 horse-power with gas-driven units of 3,000 to 4,000 kilowatts each. envisaged by some sanguine enthusiasts not long ago, will ever be realised with the gas-engine as it now exists. The largest class of such engines cost for the engine alone, just about as much per horse-power installed, as a steam turbo-generator complete costs per kilowatt. Having to drive a slow-speed generator, the need of very heavy foundations still further increases the cost of the large gas-driven unit. Where special fuels are readily available the gas-engine has, nevertheless, sufficient compensating advantages to outweigh its higher cost, its smaller elasticity, and lesser reliability in working. Even so, Nature appears to have fixed a limit to the power which it is possible to develop in a single cylinder, which as a maximum cannot much exceed 48 in. in diameter, and this in the case of a piston speed of 1,000 ft. per minute, would correspond

to but some 900 indicated horse-power per cylinder, for a single-acting four-cycle engine. Many of the most experienced makers, indeed still prefer to construct a unit of this size with three or four cylinders, in spite of the extra cost involved. In fact, whilst a steam-turbine builder would, if desired, be prepared to supply at no immoderate cost, single units developing as much as 20,000 horse-power, there is no visible prospect of the gas-engine builder being able to compete in this regard.

Gas Turbine.

Were the gas-turbine practicable, the difficulty as to the construction of large units would be surmounted; but the result of many costly experiments, has been practically wholly negative. The turbine is particularly efficient when fed with gases of low density, but a gas turbine cannot in practice exhaust below atmospheric pressure.

Conclusions.

Everything, therefore, points to the steam-engine maintaining its present position; but the oil-engine, and perhaps the gas-engine, will find a steadily increasing use where the demand for power is below 500 indicated horse-power.

Radical changes in the methods of generating power by gas, such as have been proposed by Mr. Humphrey may falsify these conclusions, which are intended to apply only to the existing type of internal-combustion engine. The results of the experiments now being made by Mr. Humphrey's licensees in Germany, with a unit designed to develop 1,000 horse-power, will be awaited with interest, as also those of further investigations into the possibilities of the Humphrey pump as a solution of the problem of jet-propulsion.—Engineering.

THE LOSS IN POWER IN GAS ENGINES AT HIGH ALTITUDES.

In a recent issue of the Engineering Review there will be found recorded the case of a large gas plant which was some time ago exported from Great Britain to a British colony and erected at the location several thousand feet above sea level. The engines did not give the power expected from them, and several reasons were advanced to account for this deficiency. It was finally concluded that the loss of power was due to the altitude of the power station. Upon investigation of the theoretical and practical considerations involved it was found that there is a loss of about one per cent. of the indicated horse-power for each 1,000 feet increase in elevation. The effect of an increase in elevation on an engine with a low ratio of compression is slightly less than on an engine with a high degree of com-

ROTATIVE DRY VACUUM PUMPS

Fred H. Moody, B.A.Sc.

The vacuum pump as an important factor in the production of cheaper power, is receiving the attention of engineers in general at the present time to such an extent that a few words on the subject might not be amiss.

There are two distinct general classes of vacuum pumps—the wet and the dry. With the wet vacuum pump, everybody is more or less familiar, it being what is commonly called an air pump, used for maintaining a vacuum in condensers or other exhausted receptacles. In this form the valves are usually of the disc rubber lift type, sealed by the water passing through the condenser or apparatus to which the pump is attached, or else by water introduced for the sole purpose of sealing the valves and at the same time absorbing the heat of compression.

It is not with this type but with the rotative dry vacuum pump, a comparatively recent development, that this article deals. In this class of pump, which uses no water in the cylinder or valves as in the wet process, the heat of compression is absorbed by a water

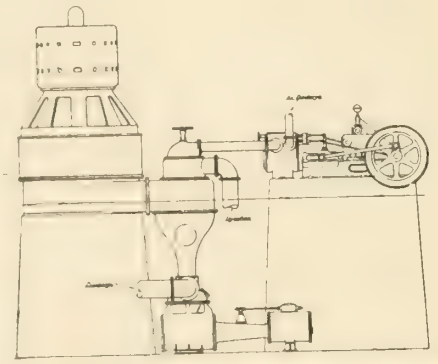


Fig. 1—Turbine Installation with Ordinary Air Pump and Rotative Dry Vacuum Pump.

jacketing system that completely envelops cylinder, heads, and passages. This brings out a very superior point in favor of the rotative dry vacuum pump, for, having no water to handle in the cylinder it can attain with safety, high speeds; also, being rotative tends to increase possible speeds, as well as decreasing the clearance materially, due to a positive length of stroke. The latter features are not distinctive, however, as the ordinary air pump is occasionally rotative.

There are numerous commercial uses for vacuum pumps, e.g. the exhaustion of vacuum pans and evaporated processes in sugar refineries in general, condensed milk plants, distilling plants, chemical and dye works, glue works, the manufacture of prepared foods, medicine, etc., preserving processes, the production of vacuum in central steam condensing systems and steam turbine work. Besides the above there are numerous special uses for vacuum pumps, two of which came under the writer's notice recently. One was the mecnanical handling of safety razor blades by the Gillette Co., between the heating furnace and the oil bath; and the other, the rather prosaic matter of picking cranberries, both of which have proved quite successful.

In nearly all cases the dry pump has been the one preferred, for various reasons,—the principal being the higher vacuum possible. For steam condensing plants this is particularly desirable, the engine efficiency increasing considerably with increases of vacuum. As is well known the efficiency obtained by Carnot's cycle is the ideal sought by engineers, and is expressed by the following equation:

$$\text{Eff.} = \frac{T - T_1}{T + 461.}$$

Where T is the absolute temperature Fahr. of the entering working fluid and T_1 of the outgoing working fluid—in a steam engine, the live steam and the exhaust steam respectively. At high vacuums, the temperature corresponding to the pressure varies quite rapidly for small pressure changes; and accordingly the Carnot's efficiency increases quite rapidly as the vacuum increases, particularly so at the very highest vacuums. As is now quite generally known the actual efficiency of a reciprocating steam engine gets further away from Carnot's as the vacuum increases, while the reverse is true of the steam turbine. Thus, while there is a considerable increase in actual efficiency at high vacuums with the reciprocating engine due to the increase in Carnot's efficiency being greater than the increasing discrepancy between the actual and Carnot's efficiencies yet the increase is considerably more marked in turbine installations. It is for this reason that in the latter case, great attention is paid to high vacuums in the condensers. Rotative dry vacuum pumps, as pointed out before, appear to be best adapted to this work. The General Electric Co., and Geo. F. Blake Mfg. Co. conjointly carried on a series of tests recently to ascertain the exact increase in efficiency in turbines due to high vacuums, but the writer has been unable to obtain the results of these tests.

In condensers using rotative vacuum pumps an ordinary air pump is used in conjunction with the dry pump to merely handle the water. Fig. 1 shows such a turbine installation. In evaporative processes, higher vacuums do not cause much economy as the total heat of evaporation decreases but slightly for the lower boiling temperature caused by increasing vacuum, the lower boiling temperature, however, is itself a desirable feature in many such processes, as for example, condensed milk.

Fig. 2, shows the cycle of operation, which in general appearances resembles a steam card. A positively operated slide valve of design to be considered later, opens the cylinder after the receding piston, which draws in the rarified vapor from the receptacle being exhausted, at the pressure in that receptacle. At the end of the stroke, the port is closed, and compression of the entrapped vapors commences. The other side of the piston, which at the end of the stroke is filled with vapor at the pressure of the

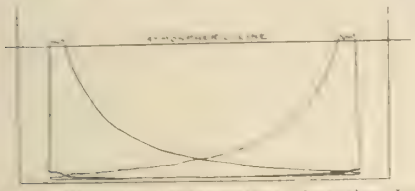


Fig. 2—Diagram of Operation, Rotative Dry Vacuum Pump.

discharge, is by-passed into the vacuum side of the cylinder, immediately after the suction port is closed, which nearly equalizes the pressure on each side of the piston. This increases the pressure of the vapor being compressed. The line of compression follows a curve, which while not an isothermal in the strict sense due to leakages, which change the volume, is nevertheless nearly a constant temperature line, owing to the very efficient water-jacketing employed. At atmospheric pressure this compressed vapor is discharged by a valve on the back of the main valve before referred to. From there to the end of the stroke, the clearance volume vapor is equalized in pressure with the other side of the piston. The reason for so doing is quite apparent, a very high volumetric efficiency being thereby made possible, though to be exact a thermodynamic loss occurs due to expansion without any useful work being performed. If this equalizing of pressure had not occurred, but instead expansion had been allowed from the atmospheric pressure, it would have been impossible to ever reach the pressure of the vessel being exhausted on account of the clearance unless the stroke volumes were much increased For example consider the clearance volume to be 10 per cent. of the stroke volume (a conservative figure). As the expansion is nearly isothermal due to the water-jacketing, the pressure change would be inversely the volumetric change, which is 1 to 11, because P.V. is the equation of the isothermal. This would mean a final pressure of 2½ inches of mercury. As 1 inch and below are common vacuums, this method cannot be employed, for even if the clearance volume were decreased enough to give more than the necessary pressure range, the volumetric efficiency would be so small that a larger machine to do the same would be required. The thermodynamic loss is thus compensated for by the mechanical gain. With this method employed volumetric efficiences as high as 96 per cent. are obtainable. Right after the end of the stroke, the by-pass is closed and immediately thereafter the suction passage is opened, and a fresh charge drawn in, its cycle continuing indefinitely. The card shown is from an actual pump and shows diagrams for both ends.

The matter of design to fulfil certain conditions cannot be treated very fully theoretically, experience having proved best. An approximation can be arrived at however, introducing certain experimental factors. Take as an example a vacuum pan in a sugar refinery. The amount of vapour (i.e., its volume) given off at a certain vacuum is known. Theoretically, twice the stroke volume by the speed is equal to this volume of vapor. But there is a loss due to the volumetric efficiency being less than unity, and also from the fact that leakages occur between the high and low pressure sides of the piston, and also at the gland, which increases the volume to be handled. To take care of these losses experimental factors have to be introduced which increase the size of the machine from 25 to 40 per cent. depending on the capacity of the machine. As a machine under different conditions will not act the same, the operation of the machine is made flexible to take care of

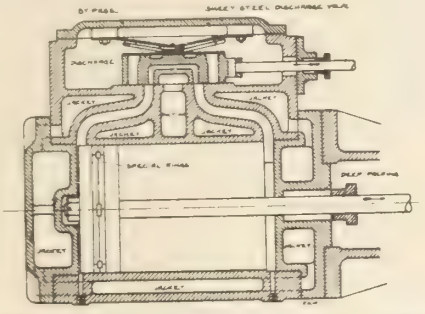


Fig. 3—Rotative Dry Vacuum Pump Cylinder Section.

this, it being designed to operate equally well considerably above or below 150 r.p.m. which is considered to be the best speed for most purposes. This flexibility requires a heavy fly wheel and a governor that may be adjusted. For the latter, a variable spring throttling governor appears to fulfill the conditions excellently, as it may be readily adjusted.

Fig. 3 shows a very recent type of R. D.V. pump cylinder in section. In general it can be seen that the cylinder and passages are identical with a slide valve steam engine, except that every part is water jacketed. In determining the size of the passages a mean velocity of 5,000 feet per minute of the rarified vapor is adopted, practice having shown that to be reasonable. This, considered with the size of the cylinder and usual speed of 150 r.p.m. gives the passage area. An excellent water jacketing scheme is employed whereby every part of the cylinder, heads, and passages is surrounded by cooling water. The reason of this might not seem apparent at first, but when we remember that vapor at ½ inch pressure and 60 deg. Fahr. increases over 1,000 degrees when compressed adiabatically to atmospheric pressure, we see that considerable heat is generated. In the R.D.V. pump the heat generated would not be so intense owing to the by-pass vapor and leakage. With the complete water jacketing there is practically no increase in temperature.

Various types of valves essentially the same as that shown in Fig. 3 have been used until the present L.V. type shown in that figure is now used exclusively in all Blake pumps. The valve is essentially an ordinary D. slide with a by-pass passage through the bridge between ends and the ends themselves extended as in the main valve of the Meyer steam valve. The valve operates much as an inside admission D. slide valve, suction entering through the centre cavity, and discharging into the two end spaces. From these two end spaces the air is let out by a sheet of Vanadium steel on the back of the main valve, and which opens with the slightest increase of pressure on the inside over that on the outside. This is simple and has proved quite efficient. The by-pass is wide open at both ends when crank is on dead centre, i.e., the valve is on its centre position for crank dead centres.

One of the vital parts of the pump is the piston, for much of the leakage occurs there and, as previously pointed out a small leakage to the suction side decreases the amount of fresh vapor that can be handled per stroke. A special piston ring is utilized. This consists of the usual uniform thickness piston ring, cut into an even number of pieces, from 6 to 8 inches long, with T-shaped pieces fitted into circumferential grooves. Pressing radially outward on these T pieces are coiled springs, which maintain a uniform pressure of the rings against the cylinder walls.

As it is impossible to completely eliminate all leakages past the piston, another plan has been adapted for extra high vacuum work such as exhausting lamp bulbs. This method consists in reducing the maximum pressure differences on the two sides of the piston by making the process two-staged. Two cylinders are arranged tandem, each similar to a single stage machine. The first takes the rarified vapor from the receptable being exhausted and discharges into the second, which in turn discharges into the atmosphere. Vacuums within 0.1 inch of the barometer are possible by these means. All the large lamp companies use this type for bulb work, for high vacuums are particularly desirable there, adding materially to the lamp life.

ELECTRICITY FOR STATIONARY ENGINEERS

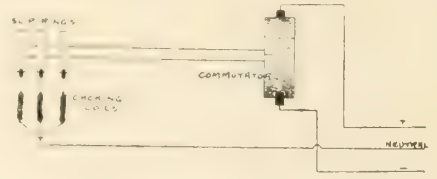
USE OF ROTARY CONVERTER IN THREE WIRE SYSTEMS.

By J. A. S., Newcastle

At the present day the increasing number of electricity supply systems which distribute energy over wide areas renders the consideration of the problems of transformation and distribution especially important. This is necessitated by the fact that, in order to economize on transmission losses, it is practically universal practice to utilize a high tension alternating current system of power transmission from the generating station to conveniently situated substations throughout the area of supply, at which substations the power is stepped down from the transmission pressure to a voltage suitable for entering shops and private houses. In some cases an alternating system of distribution is adopted, static transformers being used for conversion of pressure, but in other instances it is considered more advisable, either from the point of view of utilizing existing plant in the distribution area treated, or for special reasons connected with the type of industrial plant supplied, to transform the high pressure alternating current into low tension direct current for distribution.

A point which has received much attention in this connection is the question of the type of rotating converting machinery to be used. There is no doubt that simplicity of working is increased considerably by the use of motor generators, inasmuch as the electrical is separated from the mechanical interlinking. The combination of a synchronous or asynchronous motor with a separate direct current dynamo presents fewer difficulties to the mind of the ordinary substation attendant than a rotary converter, where the two functions of motoring and generating are carried out in the same set of coils, and where the attendant has to exercise a higher degree of technical knowledge or imagination to predetermine the effect of his regulation, or to make out what is going wrong in the case of an accident. At the same time there are two practical points of advantage in connection with the rotary converter equipments which often determine their installation. The first is the amount of ground space which they occupy, this being a most important consideration where, as in a good many cases, the substation has to be placed underground or in restricted locations, and the second is the saving of cost of a rotary converter equipment as compared with motor generators of the same capacity.

In one installation of this nature where a rotary converter equipment was put in to convert a high pressure alternating supply into a low tension direct current three wire distribution, a difficulty arose which is quite special to this type of plant, and it may therefore be of some interest to describe the method adopted to overcome the trouble. The converter was arranged on its high tension side to receive three phase alternating current through transformers, and in the other was used in similar fashion to an ordinary direct current generator supplying the three wire system. In course of working, a considerable amount of trouble was experienced due to the unequal loading of the two sides of the



Use of Rotary Converter.

three-wire network, and it was discovered that quite small inequalities produced a very large difference in the voltages of the two sides of the system.

The great difference was probably due to the reactive effect on the magnetisation of the rotary converter produced by the want of balance of the direct currents in the machine, and in order to have put the matter right by the installation of an ordinary balancer, plant would have to be installed of considerable capacity in order to ensure that the voltage difference of the two sides was kept down to a sufficiently narrow margin.

In order to overcome the trouble a method was adopted of providing what might be described as a "phantom" earth on the direct current side. This was accomplished by connecting the neutral feeder of the three wire system through three choking coils, one in each phase of the alternating current circuit, to three slip rings placed on the shaft of the converter, and connected by tappings to three equidistant points on the winding. The three choking coils were of sufficient capacity to damp down any play of current due to inequality in the phases, but allowed sufficient current from the direct current end of the system to flow back to the alternating current windings as required, and so to restore magnetic balance. The illustration attached shows clearly in diagrammatic form the arrangement made.

This adaptation was found in practice to meet with complete success. An out of balance current of the nature of 200 amps representing a considerable proportion of the total output of the converter only resulted in the difference of one volt between the two sides of the direct current system.

ELECTRICAL SPARKS.

The electric fan, which adds much to summer comfort, is far from useless in the winter. Shopkeepers have found that the circulation of air which it creates is the simplest and cheapest way to keep their show windows free from frost. An electric fan used to create a forced draft in a furnace decreases materially the time necessary to heat the house in the morning, and in winter even more than in summer it may prove a useful adjunct to ventilation.

Utilization of Water Power in Switzerland.

The Swiss Industrial Water Union estimates that 60 per cent. of the total water power of the country is used for generating electricity. This is a much larger proportion than in any other country in the world. The water power of Switzerland is rated at 1,200,000 horse-power, and this year 700,000 horse-power will be used by electric power stations.

Tests for Insulating Tape.

Writing in a recent number of the Electrical World, Mr. William P. Monger calls attention to the fact that there have not appeared adequate specifications and tests for friction tape. He names six qualities for which standard tests should be set: 1. Insulation, the property for which tape is used. 2. Character of compound, a quality often neglected. 3. Adhesiveness, which mainly determines the life of the joint. 4. Mechanical strength, important mainly from the workmen's viewpoint. 5. Feet per pound. 6. Durability.

Tungsten Lamps in a Factory.

An automobile factory in Detroit has been equipped with fifteen hundred 60-watt tungsten lamps. The factory was not completely equipped when the lamps were installed, and owing to constant jars, it was thought that the lamps would be constantly failing. However, it was found that the renewals required were but 1.8 lamps per day for a period of 75 days. When a filament was broken, the lamp was given a slight tap so as to set the filament swinging, and this would ordinarily result in bringing the broken ends together and causing them to fuse. At times a lamp with as many as three filaments broken was saved in this way.

LIGHTHOUSE CONTROL.

The statement that England has a new lighthouse, all the mechanism of which is electrically controlled by the keeper, who lives on shore a mile away, conveys a world of meaning to the engineer. The accomplishment represents in a nut-shell, so to speak, the great advances made in distant control of mechanism by electrical agency. Although the spread of the idea may rob the seashore of some of its romance, it surely will mean a great gain in the personal comfort of lighthouse keepers. Isolation of the most dreary sort will no longer be the lot of keepers of the beacons on the sea.

10,400 VOLT STORAGE BATTERY.

A paper was recently read by Mr. Swinton before the Roentgen Society of England, describing a storage battery with an electro-motive force of 10,400 volts. The battery consisted of 4,800 cells. Each cell was made of a glass test tube of quarter-inch bore, containing corrugated lead sheets separated by celluloid strips. Dilute sulphuric acid was used for the electrolyte. The battery could not be safely charged at a rate of more than 10 milliamperes, while the discharging rate was under 150 milliamperes. The internal resistance of the battery was between 3,000 and 4,000 ohms. Under full pressure the current would jump a gap of 2.5 millimeters. This, however, was not absolutely steady, for the arc produced a high musical tone, and if a Leyden jar were used, the arc would break up into a series of sparks of high frequency.

MISPLACED ADVERTISEMENT CUT

Due to an overlook in our press room, a number of copies of the April issue of "The Power House" showed the water wheel cut inverted in the advertisement of Chas. Barber and Sons, Meaford, Ont. Attention is directed to its proper disposition in the present issue.

Personal and Societies

Mr. Percy McNaughton, the popular sales manager of the Dominion Iron & Steel Co., has recently joined the ranks of the benedicts.

* * *

General Manager C. R. Dark, of the city of London, Ont., electrical department, has resigned to enter the electrical manufacturing and sales business.

* * *

Mr. A. W. Davis has been appointed to the position of locomotive foreman on the G.T.R. system, with headquarters at Stratford, in place of A. J. Roberts, resigned

* * *

The Stationary Steam Engineers, of Port Arthur, organized themselves into a branch of the Canadian Stationary Engineers' Association. A good number were present and election of officers resulted as follows: President, A. Miller, Culver Road; vice-president, J. Ainsley, Banning Street; treasurer, S. Smith, Van Norman Street; secretary, A. Boyd, Wiley Street.

* * *

Mr. A. U. Cote, of Francis Hyde and Co., Montreal, has been promoted to the position of general manager of the firm. Mr. Cote is a young man of keen business ability, and his appointment will no doubt be a successful one. Mr. F. A. Jacobs has been appointed to the management of the engineering department, which is now one of the important branches of F. Hyde & Co.'s business. Mr. Jacobs has had a long experience as a practical engineer, and has been responsible for many successful contracts carried out.

* * *

The annual convention of the Canadian Electrical Association will be held this year at the Clifton Hotel, Niagara Falls, Ont., on Wednesday, Thursday and Friday, June 21st, 22nd and 23rd.

W. L. Adams, of the Ontario Power Co., is chairman of the Arrangements Committee, and W. A. Martin, Asst. Gen. Mgr. Toronto Electric Light Co., is chairman of the Papers Committee.

The last convention at Niagara Falls was held in 1906. At that time a number of the great power plants were only in progress of construction. Since then much work has been accomplished and development taken place, so that no more interesting place for an electrical convention could well be selected.

* * *

Mr. Richard Allen, of W. H. Allen, Son & Co., Ltd., Queen's Engineering Works, Bedford, England, manufacturers of high speed engines, condensing plants, pumping machinery, etc., is at present on a business visit to Canada. Mr. Allen has been west as far as the Pacific Coast, and has visited the leading cities, and locations of engineering interest. The year 1910, he says was a record breaker in the history of his firm; their output and operating success with same, never having been previously surpassed.

They have been supplying the auxiliary engine and boiler-room equipment for the most prominent and powerful ships of the British navy, together with power station units up to the largest sizes for home and foreign order. Mr. Allen attributes much of their success, in the matter of competition at least, to the fact that their shops are modern, up-to-date, and equipped with the latest and best labor saving appliances (English, American and Continental) that are to be had.

It is their intention to open a Canadian office on a early date. Mr. Allen, before sailing for England on May 31st, will visit leading cities in the Eastern States, to which he is not in any sense a stranger, this being at least his fourth crossing and return.

* * *

We regret to announce that Mr. Thomas Pringle, founder and senior partner of the firm of T. Pringle & Son, mill and hydraulic engineers, Montreal, died on May 8th, at the advanced age of 83 years. He was largely interested, and bore an important part in the work of converting part of the Lachine Rapids to purposes of electric energy, and was generally consulted on questions concerning mill and hydraulic development and equipment, particularly when difficult problems presented themselves. He had retired from active participation in the business for a good many years, leaving its successful continuance in the care of his son, Mr. Alexander Pringle, a gentleman well known as a director in the Canada Consolidated Rubber Co., the La Rose Mine, Cobalt, and other corporations.

STRATFORD NOTES.

On April 20th a number of the members drove to Tavistock and held a meeting, initiating two members. Bros. Scrimgeour, Walters, Robertson and Kastella, spoke at length on the history of the C.A.S.E., the advantage of being a member and what the C.A.S.E. could and would do by an increase in its membership.

Most of the convention committees have been appointed and every man is right down to business. Bro. Walters is chairman of the entertainment committee and is arranging for motor cars to give the visitors a sight of the surrounding country as well as the city.

Bros. Kalbfleish have offered their motor bus.

The souvenir without a doubt will be the best the C.A.S.E. has ever had.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

ISSUED THE FIFTEENTH OF EACH MONTH BY

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Vol. IV MAY, 1911 No. 5

THE POWER HOUSE.

With this issue of The Power House, Mr. Peter Bain, M.E., assumes responsible editorship. Needless to say, Mr. Bain's practical and mature experience in the design, equipment and operation of power plants, his intimacy with the requirements of the various grades of operators, as instructor in steam and electrical engineering for many years in Montreal, and his success as associate editor, are features which guarantee increasingly mutually beneficial results to all in the wide field of power, and to us as publishers of this journal.

Mr. J. H. Williams, asst. shop engineer, the C.P.R. Angus shops, Montreal, becomes assoc. editor, and he too, brings to the work of the paper, a wide and comprehensive knowledge of power development, equipment and operation in the steam, electrical, hydraulic and gas engine fields.

We bespeak our readers' co-operation by correspondence and inquiry in our editorial work.

BUYING SUPPLIES.

Who should have the buying of the oil, packing and other engine room supplies—the engineer or some member of the office staff? The average engineer will doubtless think that there can be only one answer to such a question; and that since he has to use the supplies, he should be allowed to buy them. Such an argument is perhaps natural, if not over-logical. Where the plant is not a large one and the engineer is a man of considerable experience and thoroughly trustworthy, it is often advisable to leave the ordering to him.

When we say trustworthy, we do not mean merely honest, for a man whose integrity is beyond question, may prove a very poor buyer. He may be too conservative to try anything he has not had experience of, or he may be too easily influenced by the glib tongue of the last salesman who paid him a visit.

When it is desired to change the buying system over to the care of the office staff, after it has been in the hands of the engineer for a considerable time, a good deal of tact must be exercised in announcing the change. We are often in receipt of letters on this subject from stationary engineers, men of many years' experience, and who evidently take pride in keeping down their operating costs. They had been in the habit of buying the necessary supplies, and were rather surprised when the office suddenly took the matter out of their hands, with apparently no reason, and without complaint as to the way they had been handling it. These companies now have engineers with a grievance, due to the want of a little consideration and explanation.

On the question of trust that each individual company can place in its chief engineer we venture no opinion; that being a personal matter between themselves, and warrantable or otherwise on proved experience. We think, however, that at least consultative opinion on purchases should be an engineer's privilege; the purpose of this journal being to help and educate him in the proper discernment and selection of plant accessories, to the ultimate advantage of the plant proprietor in addition. Some men we know cannot be trusted, and all the educative influences possible, will not improve them. Others again, can and should be trusted, and no microscope is needed to pick them out. These latter unless they bear their part in the selection of their supplies form a broken link in what may otherwise be an apparently perfect efficiency system, and until welded up, the plant continues to suffer.

FIFTEEN MILES IN SIXTEEN HOURS.

A good many years ago, it was our privilege to see and know something of a steam propelled barge, engaged in the coal-carrying trade on a large inland fresh water lake. The crew consisted of one man, who acted in the combined capacity of owner, captain, deckhand, engineer and fireman. The barge was some 70 feet long, 14 feet beam, 6 feet molded depth, and drew about 3 feet of water, loaded. Her motive power consisted of a vertical boiler, single cylinder non-condensing engine (a puffing Billy) with a one-blade propeller.

The steam pressure carried was 20 pounds per sq. inch. The propeller was not one-bladed by design, but became so by accident, and remained so by indifference and carelessness. Fifteen miles in sixteen hours was the rated speed of sarcastic humor.

We are apt to believe that modern equipments, methods and operations, leave no room for the existence of such seemingly old time happenings. Without making a too literal application, are not individual experiences much in the nature of a "15 miles in 16 hours" rate? Is it not a fact that plant equipments are in operation that attain their purpose at a like rate, and may it not be true that methods of manufacture still flourish by which output, whole or part, is got by a one-blade propeller as it were; the original design and purpose having been side-tracked by carelessness and indifference? Individually, we have each one, some blades fewer than we were designed for, or have chips off some of them. We have not attained to that prominence in our profession we had mapped out for ourselves, and have not as a consequence secured its cash equivalent. We reason that our personal equipment is all right, and point to want of encouragement, or in other words to adverse undercurrents and headwinds. Are we sure that our motive power is all it might be, and if so, are we delivering it with a

full-blade propeller? Are we putting our knowledge to telling practical use?

Knowledge is power, only if applied, and unless it is so, we are somewhat in the position of a boiler in which steam is generated for the purpose of blowing it off again at the safety valves. Unless we apply our knowledge effectively, we cannot expect to make satisfactory progress. This barge made little headway, due to the indifference of its owner in the matter of supplying the lost and broken propeller blades. Our indifferent showing may be in the half-hearted way we go about our duties; in the thoughtless handling of some emergency when we knew better; or in the determined attitude of being content with doing as little as we can, for the little we happen to get.

Water seeks its level and all commercial affairs adjust themselves to a business rating and value. We may be sure then that the universal tendency leaves no "stepbairn," and that we too, if in addition to having the power, possess in its entirety the propeller with which to deliver it, will find that promotion and pecuniary return will be our reward, and that instead of being rated as equal to 15 miles in 16 hours, we may approach more nearly to the real thing, and attain 15 miles in one hour. Intelligent application of what we know is the full-bladed propeller by which we not only make progress, but impress others and spur them on to equipment and effort to keep alongside of us.

SUNDAY WORK.

There is a growing disposition on the part of large and small manufacturing corporations to eliminate Sunday work from their business conduct and operation. Systematic arrangements have been put in force, whereby repairs and overhauling, allowed previously to accumulate until shutting down time on Saturday night, are now attended to at once, with the result that an output gain has been recorded and a saving effected in repairs cost. It may be worth pointing out that efficiency of the Sunday worker was never in any sense comparable to that shewn by the same man on any or all of the other six days.

Superintendents as a rule shew somewhat more consideration for, and push less hard the Sunday operator (exhibiting, as it were, a sort of pity for the "poor devil" and patronizing attitude) due doubtless to their having donned for that day the suit of religious atmospheric sentiment. The workman too accepts the Sunday work situation as more or less of an act of supreme graciousness on his part, and between the two, the decreased efficiency already noted is the result. Aside, however, from these observations, the organized and systematic scheme of Sunday labor neither conduces to civilization, intelligence, health, nor individual, social and national prosperity.

There will always be work necessary of doing on Sunday, but when definite plans are formed, as they now are in the preceding days, and the same precision of estimate as to the labor necessary to carry them out as prevails in the usual week-day conduct of business, fewer men are required to have them carried out. The diminution of Sunday labor we have stated, is a gain to the employer financially wherever it has been adopted. On the side of the employee, financial gain may not be apparent, and may as a matter of fact be financial loss. To the workman whose wages rating is so much per day, it means a certain financial loss and as such is felt keenly. On the other hand, the man who is rated by the week or month is at a distinct advantage, because he draws the same salary and may have four off Sundays.

We are disposed to think that the cessation of Sunday labor by week-day foresight provision, is an all round advantage in spite of its seeming hardship on some. Every man is all the better for the rest which the day is intended to bring, and is placed in a position thereby to effect an improved moral and intelligent manhood attainment. Some men, we know, are keen on all the overtime and Sunday work they can lay their hands on, and many or all of them may need the cash equivalent that these bring, in order to live, it may be, or to provide the wherewithal to put their family in possession of a good education and business equipment. Only compensation on the employer's part will effectively cure this condition of affairs.

The movement to cut out Sunday work, has we think originated with the employer, and why not with the employee, we are rather at a loss to understand. The employee needs more the relief from Sunday work than physically and mentally speaking does the employer, and being so, its elimination should have originated with him, In any case, who originated the idea is not of so much vital importance. What is important can be largely the employee's part, and he individually and by means of his trade organization can make his influence felt.

Engineers, firemen and electricians in power plants are more or less subject to Sunday labor, which while to some extent absolutely necessary on one or more occasions per month, might easily with advantage be greatly curtailed. All of these men have more or less pride and care for the successful continuous operation of their plants and the security of their positions if you like, to safeguard and provide against accident and breakdown emergencies, by "doing as it were now," what is otherwise left-stand-over until Sunday. This leaving-over is simply after all a question in large measure of dollars and cents. We believe that employers of power plant operators like those of the large steel and cement manufacturing concerns, have found of their workmen, that better results are to be gained, by having more efficient, because more hearty service rendered in the 5½ or 6 working days, with the equivalent outlay of the seventh added to the payroll of the others.

Cases occur to us where considerations such as these were effectively employed, and where, instead of the whole engine and boiler room staff being on duty with their work-a-day cap and overalls every Sunday in the year, you would if particularly interested have noted that each and all took a peep-in at the plant some time of the day, dressed in at least a knock-about suit, cap, and smoking a high-day and holiday pipe or cigar.

Wild horses won't keep engineers away entirely from their plants; machinery, engines, boilers and pumps have a fascination for them amounting almost to adoration, and being so, the proper attitude to be adopted in securing in large measure the abolition of Sunday labor, as far as the power plant staff is concerned, lies in the installation of stand by equipment which will permit of week-day overhauling, and trust in the engineer's interest in his charge, to do in some of the six days what in many cases is now done on the seventh and remunerate him the same for the former as the latter.

When you think you have reached the top round of the ladder, don't forget how to yell for more ladder.

• • •

The man who gets ahead, must have a head to begin with.

Correspondence

Discussion on Previous Articles—Readers' Queries and Comments. Remuneration for useful Ideas

ENGINEERS' WAGES.

I agree with "Oilcan" in a large part of what he writes in the March number. Perhaps "Oily" has had greater chances to study engineers. I do not know "Oilcan," therefore cannot determine whether he is correct in his statement or not.

Personally I am not objecting to my own treatment as an engineer. I am receiving a fair remuneration for my services, but I have known men who have been efficient engineers for 20 years or more who are still working for wages little better than that received by the common laborer. The engineers in question neither use alcoholic liquor, play the races, nor shirk their duty; they simply cannot get better paying jobs and have grown old in their chosen profession, hoping that a day was coming when their grit in holding on would be recognized.

The same advice as "Oilcan" gives was constantly given to engineers by a leading stationary engineers' paper over 20 years ago (Power of New York) and wage conditions are practically the same to-day as they were then.

What the engineers require are suggestions which will enable them to secure better remuneration for their services during the present generation. It is only begging the question to say that there is room for improvement amongst the engineers themselves. There is no body of mechanics in the world which could not improve itself, for no man or mechanic is perfect

Engineers as a rule are careful and look well after apparatus in their charge. I do not believe a man should plug his business or trade, neither do I wish it understood that I am doing so. If the work of engineering were not a fascinating and interesting business there would be mighty few good men at the job except in the large plants, but I would like to plug the man or men who compel engineers to work for starvation wages. No man with a grain of sense would judge a man's ability to make good by his certificate, as "Oilcan" suggests some do, and a man is only so judged by the inexperienced in engineering.

I assisted to instal engineering equipment in river steamers 25 years ago, and have spent my life since then at [illegible] and heat engineering, so I believe I am also in a position to know something about engineers as well as friend "Oilcan."

Study is good.

Faithful attention to the safe and economical operation of the plant is praiseworthy. Working seven days a week for six days' pay is generous. Engineers are doing all this in thousands of cases at present. Send along some other suggestion that will give a man a reasonable guarantee that he will get a man's pay after say 10 years' experience.—Jim Scotch, Toronto.

BOILER DESIGN, CONSTRUCTION, ETC.

In response to numerous inquiries from readers all over the Dominion asking us to make a pronouncement on the original issue between H. S. Jeffrey and "Laddie Cliffe" we will publish in the June number of "The Power House" what appears to us the generally accepted idea and practice in steam boiler design, construction, etc.

It is a matter of gratification, that "Laddie Cliffe's" entry into the arena, served to show, if nothing else, how keenly interested our readers are in this important subject, and we hope that the same lively interest is being taken in each of the other departments of our paper.—Editor.

READERS' QUERIES.

W. Congdon, Chatham, Ont., wants to know whether carrying steam at 100 pounds pressure takes more or less fuel than does carrying steam at 120 or 125 pressure.

J. Elgie, St. Thomas, Ont., requires method of figuring out the size and pitch of propeller for a boat 30 feet long, 4 feet 6 inches wide at a distance of 14 feet from the bow. The engine is of 30 horse power, running 410 r.p.m. and the speed of the boat is 8 miles an hour.

Q.-1.—Harry Moore, Winnipeg, wants to know what heat must be given to 1 pound of water at 80 deg. F. to convert it into steam 380 deg. F., Regnault's formula for total heat of a pound of steam from water at 32 deg. F. being $H = 1082 + 0.305t$ where t degrees is the temperature of steam. How many pounds of this steam are equivalent in total heat to the calorific power (15,000 units of heat) of a pound of coal.

Q.-2.—How many foot pounds of work are done in converting 1 lb. of water from a temperature of 100 deg. F. into dry steam at 281 deg. F., corresponding to an absolute pressure of 50 pounds per sq. in.? The volume of 1 lb. of dry steam at that temperature and pressure being 8.31 cubic ft. At the same time tell me what is the external and internal work done during formation of the steam.

Q.-3.—Into 112 oz. of water at 45 deg. F. are poured 20 pounds of water at 160 deg. F.; 4 lbs. of ice at 32 degs. F. are added. What is the final temperature when the ice has just melted?

S. K. B. asks to know the correct method of calculating the steam consumption of an engine from its indicator diagram.

A. I. J., New York City, makes inquiry as to names and addresses of Canadian firms in the novelty brass spinning and stamping business. The assistance of our readers in furnishing the required information is solicited.

Ralph Innis, Dartmouth, N.S., asks the following questions: (1) Is it practical for a steam engine to run without lubricating the valve and piston? (2) Is it practical to run a high speed engine using super-heated steam without lubricating valve and piston? (3) If so, what constructional details have to be attended to?

C. R., Cape Breton, N.S., requires the proper diameter of cylinder for a hoisting engine geared to a drum 4 feet diameter, by gears whose ratio is 1 to 4. A weight of 4,000 pounds has to be hoisted a height of 180 feet in 4 minutes. The stroke of the engine is $1\frac{3}{4}$ times the cylinder diameter, and the mean effective pressure, 45 pounds per square inch.

MacMillan Cockburn writes:—In the plant where I am employed, we have a battery of four boilers. A large smoke-box passes over the four, through the wall to a stack outside. We have never been able to find a paint or smoke-stack black of any make that would stay on this smoke box over a month, and we would like to know if any of your readers can suggest some coloring that will not come off so quickly. Is

there a white paint made for this purpose?

J. W. H., Wilberforce, Ont., asks information regarding books on running steam drills, also sharpening and tempering drills for hard rock work.

Western Engineer writes that he has recently taken charge of a steam plant which has been through a fire. As a boilermaker was called in to repair the boiler, I did not see the full extent of the damage. I want to know what weak points to look for as a result of the fire ordeal, and the best means of caring for them?

The boiler is of the horizontal, multitubular type with dome. All pipes come from dome, except feed water, water gage and tail. Previous to the fire, the boiler was set in brickwork, and brick lagged with air space, with the dome unprotected. The fire destroyed all pipes and fittings. The usual working level of water was in the boiler at the time of the fire. The dome has a flat head, gusset stayed. The vertical and head seam, and some pipe flange rivets leak, either under the heads or as blow holes on seam edges. One shell sheet at the double riveted butt joint leaks similarly.

A FRIENDLY CRITICISM.

Now I think it is too bad for you to try and delude and lead astray your trusting readers in such a manner, and that, too, after telling us that you wouldn't do it.

If you don't believe me please look up March "Power House," and in "Practical Questions and Answers," question 48, tell me if that is not a catch question of the first order, and to make matters worse and rub it in, you try and work it out for us.

You say that 1,000 lbs. × 75 ft. = 75,000 ft. lbs., which is wrong, and that 33,000 ft. lbs. = 1 h.p. Now that 33,000 ft. lbs., if I remember right, was got by multiplying 33,000 lbs. × 1 ft. high × 1 minute of time.

Weight, space, and also time are requisite and I am sorry to see that you think so little of time as to neglect it.

Now please accept my thanks for the many good and instructive pieces I get from your valuable paper, and I am glad to get this little one in on the chief for he is just human, too.—W. Huxtable.

TRADE NOTES.

Farand and Delorme Ltd., manufacturers of steam boiler, etc., are putting up a new factory building on Richmond Street, Montreal.

The Nernst Lamp Company, Canadian department, advise us that they are now handling the Westinghouse Nenst Lamp at their address 78 Bay Street, Toronto.

The H. W. Johns-Manville Co., New York and Toronto, have placed on the market a cement which will stand 3,000 degrees F. good for furnace setting of various types and for patching and facing bricks in places in the fire zone under various conditions.

H. L. Peiler & Co., agents for Canada of the Bundy trap, Mason's valves, etc., took possession on first May of new and very much larger premises at 380 St. James St. Montreal. Mr. Peiler's new office occupies the ground floor with show windows and is located in what is know in Montreal as "Machinery Row." This step has been necessitated by increasing business.

Warden, King, Lowden have taken over the business carried on formerly by Lowden & Mead. They will handle Morehead steam traps, Cyclone grates, Bird-Archer boiler compound, and Crandell packings, and have recently added other lines of power plant supplies. The main offices of the company are at 13 Bleury Street, Montreal, Que.

The Montreal branch of the H. W. Johns-Manville Co. moved from their offices in the Eastern Townships Bank building, Montreal, on May 1st to a new location, No. 450-452 St. James Street. The building has five floors, and a full stock of their entire line will be carried.

The Goulds Pump Co., Montreal, have secured the agency for Canada of the Sterling Steam Traps, manufactured by the Templeton Manufactiring Co., of Boston, Mass. The Sterling Traps enjoy a considerable sale in the United States, where they have an enviable reputation for merit.

Vulcan Tube Cleaning Systems, Ltd., have moved to their new offices and works at 4 Bonsecours St., Montreal. Recent contracts received by them are: equipping soot cleaners on four Wickes upright water tube boilers at the Chateau Laurier Hotel, Ottawa, and on three new Babcock and Wilcox water tube boilers in the Windsor Street Station extension, Montreal.

Only recently these machines were placed on the Canadian market, yet they are now installed in a large number of plants in Eastern Canada,

D. K. McLaren, Limited, Montreal, manufacturers of leather belting, took possession of their new premises at 351 St. James Street, on first May. This is an important milestone in the history of the company, as the new building is one purchased by them and has a capacity of nearly double their previously leased premises on Craig Street. Ample floor space, splendid lighting facilities, and all requirements of a first class factory are to be found in the new quarters. A handsome suite of offices finished in hard wood is located on the ground floor.

W. T. Glover & Company, Limited, electrical cable manufacturers, Trafford Park, Manchester, and Royce, Limited, electrical and mechanical engineers, also of Trafford Park, Manchester, wish to announce that they have opened a branch office in the Lumsden Building, Toronto, and have appointed Mr. C. S. Mallett, an engineer of wide experience, to be in charge of the work here. The work W. T. Glover & Co., Ltd., will undertake, will be the supply of underground electrical cables for lighting and power purposes, also mining work, as well as the supply of aerial wires and cables.

Royce, Limited, manufacture electrically operated overhead traveling cranes, jib cranes, transporters, winches, capstans, dynamos and motors, and are the pioneer firm for the manufacture of some of these items in Great Britain.

The Smart-Turner Machine Co., 191 Barton St., Hamilton, report the following recent orders for various styles of pumps: Gunn's Ltd., West Toronto; Colonial Wood Products Co., Port Arthur; Great Lakes Dredging Co., Port Arthur; Armes & McNiven, Ancaster; Rogers Cheese Co., Frankford; Coniagas Reduction Co., St. Catharines; Whyte Packing Co., Stratford; Thornbury Transportation & Reduction Co., Thornbury; Beardmore & Co., Acton; G. T. R.; three from Ogilvie Stores, Montreal; Steamer "Sarnia," Port Arthur, and S. C. Shorey, Napanee.

Among the recent sales of the Terry Steam Turbine Company, reported to March 1st, are the following: Marconi Wireless Telegraph Co., New York, 4 h.p. direct-connected generator; Boston Elevated Railway, 7 pumping sets; Crocker-McElwain & Co., Holyoke, 25 h.p. turbine, direct-connected to a pump; P. W. Rouss yacht, Winchester, 35 h.p. fan unit; Kirkman & Sons, Brooklyn, N.Y.; 70 h.p. condenser circulating set; Birmingham Gas Works, Birmingham, N.Y., 60 h.p. blowing unit; Empire Steam and Iron Co., Mt. Hope, N.J., 30 h.p. circulating set; United Electric Light Co., Springfield, Mass., 50 k.w. generator set; Fisherman Cold Storage Co., Provincetown, Mass., 25 h.p. pumping set; Union Railways Supply Co., Atlantic Highlands, N.Y., 25 h.p. forced draft set; Cleveland Electric Illuminating Co., Cleveland, O., 380 h.p. turbines to drive boiler feed pumps; Consolidated Coal Co., Fairmount, W. Va., 200 h.p. pumping sets; Sandusky Portland Cement Co., Dixon, Ill., 50 h.p. condensor circulating set.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

HIGH AND LOW SUCTION TYPE COMPRESSOR.

By Tungsten

There has recently been installed in the plant of the Vancouver Ice and Cold Storage Co., Vancouver, B.C., an 18 by 30 inch, F. W. Niebling Co. compressor of a type showing a number of interesting features. It is what is known as a high and low suction compressor, in other words, the machine can be used for three different suction pressures, and is claimed to be the most economical type in existence. Illustrative of the advantages claimed, is the following table of temperatures, pressures and displacements.

Deg. F.	Deg. F.	Lbs.	
—5	—17	5	10,700
0	— 8	10	9,000
+10	0	15	7,500
[illegible]	+ 6	20	6,000
+20	+11	25	5,400
+25	+17	30	4,800

It will be noted that where a temperature of 5 degrees below zero is to be maintained the cylinder must displace 10,700 cubic inches of gas, whereas with a temperature of 25 it only has to displace 4,800 cubic inches; consequently this machine, by being able to pump the different pressures will do all the way from 15 to 50 per cent. more work, depending upon the pressures and temperatures available.

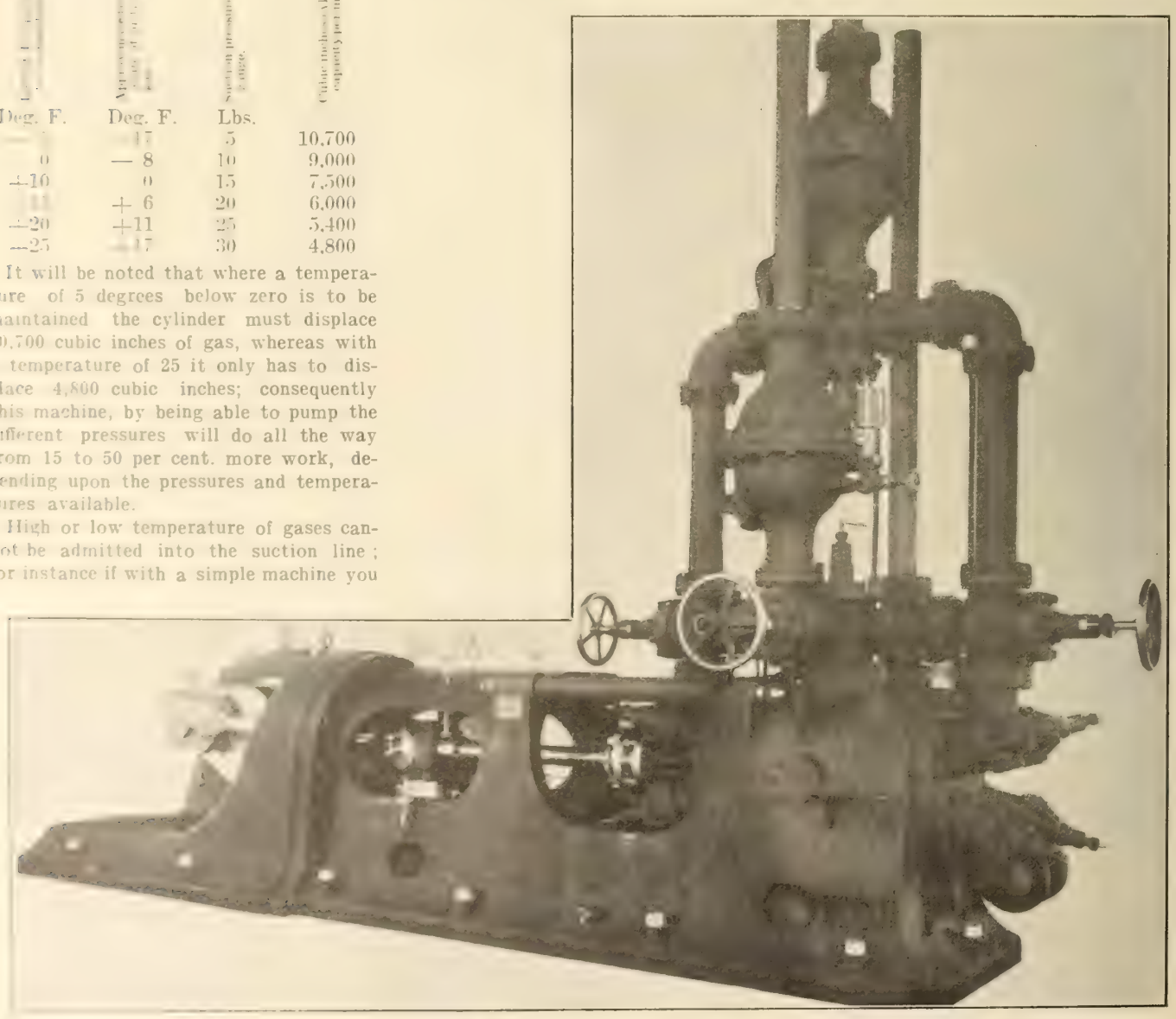
High or low temperature of gases cannot be admitted into the suction line; for instance if with a simple machine you want to operate one room at zero and all the balance at higher temperatures, this machine would have to carry the back pressure for the lowest temperature, and would only give about one half of its capacity at the standard rating, which is 7,500 cubic inches of gas displaced per minute at 15 back pressure per ton of refrigeration.

The various tests that have been made, have shown that with every 5 lbs. addition back pressure admitted into the cylinder, the efficiency is increased 7 p.c. and the horse power decreased only 3 p.c per ton so that there is a large saving in fuel.

The suction and discharge valves are so constructed that they can be regulated from the outside while the machine is in operation, and the suction valve has a piston cylindrical guard, so that if a valve stem should break or a nut come off, it is impossible for the valve to fall into the cylinder. All valves can be packed while the pressure is on and the expansion valves can have a new stem put in, without pumping out or losing any ammonia.

The special devices are covered by pa tents and the whole apparatus has been designed with a view to economy, durability and safety.

The F. W. Niebling Co., Cincinnati, Ohio, are the makers of this machine, and the A. L. Williams Machinery Co., Toronto, Vancouver, etc., their agents.



F. W. Niebling Compressor.

THE IDEAL GUARD
FOR YOUR BOILERS

The Liberty Twin Strainer.

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POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

KAMLOOPS, B.C.—The following by-laws were carried by large majorities: $30,000 for [illegible] waterworks, $10,000 for extensions of [illegible] systems, $20,000 for automobile fire apparatus, and an appropriation to buy a second lot for a large addition to the drill hall.

FRANCIS LEDGE—Work has commenced on the cold storage plant of the Canadian Fish & Cold Storage Co. G. L. Clayton is the [illegible] in charge of construction. The plant will have a freezing capacity of 50 tons of fish, and producing 25 tons of ice per day. The cost is over $75,000.

NEW WESTMINSTER—It has been decided to install a new water-pumping plant and electric lighting system.

PEACHLAND—It has been decided to install a complete new electric lighting system.

VANCOUVER—The plant of the Albion Iron Works, including the entire foundry equipment, was purchased by the firm of McDougall-Jenkins Engineers, Limited. The [illegible] who [illegible] carrying on the business of the iron works, will at once proceed with the erection of another shop. The improvements contemplated will involve the expenditure of over $150,000, and when the new plant is in operation, a force of 300 men or more will be employed. Contracts for the building of two new Trans-Pacific liners of 15,000 tons register, speed of 18 knots, will be let in England shortly; they will be on a par in passenger accommodation with the Atlantic liners of the company. They will be able to make the run between Yokohama and Victoria in ten days. It is probable that they will be ready to enter service during 1912. Messrs. Bullen, shipbuilders of the Pacific coast who are associated with Denny Bros., of Dumbarton, Scotland, have received a subsidy from the government which presages the inauguration of a big shipbuilding enterprise on the Pacific coast. The subsidy is three and a half per cent. per annum on the total cost, for a period of thirty-five years. According to the estimate of the engineers of the Department of Public Works on the plans submitted, the total cost of the dry dock, wharf, repair machinery, building, etc., will be $2,037,800. The dock will be 900 feet long, 41 feet deep and 128 feet wide.

Alberta.

STETTLER—It has been decided to install a complete new electric lighting plant, and the intention of the municipal council is to proceed with the work at once. Provision will be made for 2,500 16-candle-power lamps.

EDMONTON—Last week the burgesses of Edmonton approved of twenty-three money by-laws placed before them by the city council, authorizing aggregate expenditures exceeding $700,000 for improvements and betterments to various city services. The most important by-law was one covering an expenditure of $250,000 for increased equipment at the power house and pumping station. During the past week the city council decided to accept the terms offered by the Dominion Government in regard to the privilege of developing Hydro-Electric power at Pelican Rapids, some 200 miles north of here on the Athabasca river. The city is to commence actual construction in 1912, and must be in a position to [illegible] electric power in Edmonton in 1916. The city has the right [illegible] 60,000 horse power.

GLEICHEN—The Town of Gleichen, Alta., voted on April 26, for the second time, on a [illegible] waterworks and sewers, on account of a technical error in the original by-law, and passed the new by-law. The following contracts for [illegible] have been awarded: [illegible] Alberta Well Drilling Co., Calgary. [illegible] supply of lapwelded steel pipe—[illegible] Ltd., Calgary, for Stewart [illegible] Kerr, Alley & McLellan's valves, [illegible] Calgary Iron Works [illegible] & Iron Co., Des Moines, [illegible] Pipe & Wire Co., Red Wing, Minn. Contract G—[illegible] Co., [illegible] will be constructed by the John Galt Engineering Co., P.O. Box [illegible]

RED DEER—The Town of Red Deer, Alta., will put in a considerable amount of water and sewer extensions and a large extent of cement walks this year, under the supervision of the John Galt Engineering Co., P.O. Box 1119, Calgary, Alta.

CALGARY—The City of Calgary has just closed contracts for the following: One 1600 kw. 2300 volts, 3-phase, 60-cycle, steam turbo-generator and surface condenser -Allis-Chalmers-Bullock; one 100 kw. exciter set, direct connected to 150 h.p. Robb engine—Canadian Westinghouse; sub-station equipment, complete for 3000 kw. 12,000 to 23,000 volts—Canadian Westinghouse; nine-panel addition to power house switchboard—Canadian Westinghouse; one 350 h.p. water tube boiler, with eight chain grate stokers—Babcock & Wilcox. The 20-ton 50-ft. span traveling crane was let to Gorman, Clancey & Grindely, Calgary. The coal storage bins and all structural steel work for the complete power house was let to Philip Lang & Co., of Chicago. The power house is 132x136 feet.

CAMROSE, ALTA.—The ratepayers carried the waterworks by-law here recently, and it is hoped to have the system completed by next fall.

Saskatchewan.

MOOSE JAW—The Moose Jaw Electric Co. will build a new power house.

NORTH BATTLEFORD—An expenditure of $40,000 on new waterworks pumping machinery has been decided on.

SWIFT CURRENT—A new telephone system is being called for by tender..

PRINCE ALBERT—Sealed tenders addressed to the City Commissioners, and marked "Tenders for Electrical Machinery," will be received until Wednesday, May 31st, 1911, for the following: A. Two 100 h.p. cross compound engines, with necessary condensing apparatus, steam piping, installed complete. Tenders on engines of the following classes will be considered: (1) Horizontal cross compound Corliss engine, 125-150 r.p.m.; (2) vertical cross compound Corliss engine, 125-150 r.p.m.; (3) vertical cross compound quick-revolution engine, forced lubrication. B. 600 kw. 2,200-volt, 60-cycles, 3-phase engine, type alternator, exciter, switchboards, automatic regulator,' installed complete. C. 72-in. by 18-ft. return tubular boiler, suitable for 150 lbs working steam pressure. Specifications will be furnished on application to the City Commissioners, or R. Wright, city electrician.

Manitoba.

WINNIPEG—Winnipeg is calling for tenders for six 500-kilowatt step-down transformers for a new sub-station.

PORTAGE LA PRAIRIE—The Central Electric Co. will enlarge their plant.

NEEPAWA—Chipman & Power, Toronto, have been engaged by the municipality of the Town of Neepawa, Man., to prepare plans and specifications for the proposed waterworks and sewerage systems, estimated to cost $125,000.

Ontario.

WELLAND, ONT.—The Canadian Boving Company, of Toronto, gets the contract for the pump and turbine to be installed in the new pumping station to be erected on the east side of the canal, at a cost of $11,900. Other tenders received were: John McDougall, Montreal, pump and turbine, $14,069; John T. Farmer, Montreal, pump and turbine, $15,-250; Gould Pumping Company, Montreal, pump and turbine, $15,250; Drummond, McCall Company, Montreal, pump alone, $7,350; Smart, Turner Company, Hamilton, pump and turbine, $18,500; John Inglis & Company, Toronto, pump alone, $8,550; Wm. Hamilton Company, Peterboro, pump and turbine, $14,-450; Canada Foundry Company, Toronto, pump alone, $9,172; Escher, Wyss & Company, Toronto, pump and turbine, $14,365.

COBOURG, ONT.—Tenders for steam heating of Victoria Hall, in Cobourg, addressed to the County Clerk, Cobourg, will be received up to noon on Thursday, June 1st, 1911. Plans and specifications can be seen at the office of the County Clerk, Cobourg. George Greer, chairman of committee, Cobourg.

TORONTO—Sealed tenders addressed to the chairman of the Board of Control, City Hall, will be received by registered post only, up to noon of June 6th, 1911, for the supply of the following equipment: Pumps, vertical, electrically driven; motors and other electrical equipment; screens and cleaning apparatus; Venturi meters. Specifications and forms of tender may be obtained at the office of the City Engineer, Toronto.

HARRISTON—A special meeting of Harriston council was held on the 20th of April to open tenders for waterworks supplies and for letting contracts if these proved satisfactory. There were in all twenty-three tenders received for the different work and supplies, eight for cast iron pipe, seven for hydrants and valves, three for lead and gaskets, five for the construction of water tower. The following are the firms to whom contracts were awarded, the lowest tender in every case being accepted: Cast iron pipes and special castings, the Gartshore, Thomson Pipe & Foundry Co., Ltd., Hamilton, $31.20 per ton for cast iron pipe, and $2.75 per 100 lbs. for special castings; lead and gaskets, the James Robertson Co., Ltd., lead, $3.06 per 100 lbs., and $14.50 per 100 lbs. for gaskets; building water tower, the Hunter Bridge & Boiler Co., Kincardine, $3,505. The letting of the contract for hydrants and valves was taken up, and after hearing the merits of the different hydrants explained, it was moved and seconded that the tender of the Kerr Engine Co., of Walkerville, be accepted, at $30 each for hydrants, $24.50 for 10-inch valves, $15 for 8-inch valves, $9 for 6-inch, and $5.60 for 4-inch valves.

WELLAND—The by-law to raise $75,000 for a new waterworks pumping station on the east side of the canal, has been voted by the citizens of Welland, Ont. Work will begin at once on the new plant. Water power, as well as a supply of water, will be obtained from the canal.

MILLBROOK—The Seymour power by-law, which was voted upon in Millbrook, was passed by the large majority of 191. Only one vote was recorded against the measure. The passing of the by-law will mean a 24-hour service for the town, and all the available power required, at the cost of $25 per horse-power. The old plant has been taken over by the company, and work on the new sub-station will be commenced at once.

PENETANGUISHENE—The power house and plant of the Midland Street Railway, Light & Power Company, at Penetanguishene, Ont., will be greatly enlarged.

PENETANGUISHENE—By a vote of 244 in favor to 9 against, a by-law to raise on debentures $27,000 for the municipal Hydro-Electric power scheme carried in Penetang on Monday. Of the amount $16,500 will be used to buy out the existing private plant and $10,500 for extensions and improvements. The power will be supplied by the Simco Power Co.

ROMFORD—Six miles below the Wahnapitae Power Co. plant, near Romford, is another fall, known as Water Fall, and there Mr. Wm. McVittie has commenced the construction of another power plant. The building is designed for the installation of three units of 1250 kilowatts each, of which two will be put into service first. The third will be installed as soon as the service requires. It is expected that the greater part of the power will be taken by the Mond Nickel Co. at their new plant at Romford.

DESERONTO—Tenders will be received by Lucius E. Allen, consulting engineer, Belleville, Ont., to noon of June 4th, 1911, by the Corporation of the Town of Deseronto, Ont., for the purchase of the following equipment: One 75 h.p. Fairbanks-Morse suction gas producer; one 65 h.p. Fairbanks-Morse vertical producer gas engine; one 12x15 triplex pump, direct connected by friction clutch to gas engine, capacity 1,000 gallons per minute. Specifications and description of above equipment furnished on application.

RIDGETOWN, ONT.—The Town of Ridgetown, Ont., has practically decided to invest a sum not exceeding $35,000 in a waterworks system. The system as outlined will produce 1,250,000 gallons of water per day from artesian wells. A bond election will be held.

WOODSTOCK—A meeting of the Eel River Light, Heat & Power Company, Limited, for organization and election of directors, was held on the 21st inst., and at this meeting the

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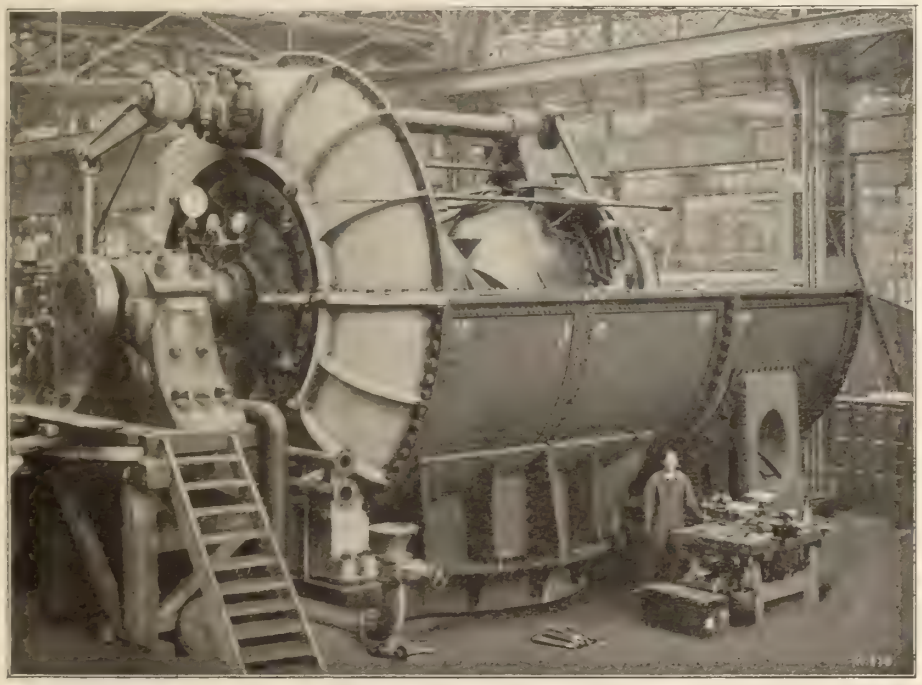

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following were elected directors: John G. [illegible] A. Macrae, R. Grover Lee, George McPhail, F. W. Andrews and H. A. [illegible]. At a subsequent meeting of the directors John G. Murphy was elected president, H. A. Connell, vice-president and general manager, and R. G. Lee, secretary-treasurer. The directors authorized H. A. Connell to proceed with the work of the survey immediately. It is the intention of the company to install a first-class plant and they have hopes to be in operation before the close of the year.

LONDON—Hon. Adam Beck, Mayor Beattie and Mr. Philip Pocock, chairman of the London power commission, were the speakers at the ceremony attendant upon the turning of the switch which started the waterworks pumps, three miles from the city, with Niagara power. Mr. Pocock said that the success of the system in London was assured. A number of St. Thomas residents were present.

BERLIN—It is proposed to spend $100,000 on the waterworks system within the next year, to include a new reservoir, with electric pumps, and a reserve standpipe in the factory district, with larger mains.

[illegible] of the Seymour Power Company is completed.

TAVISTOCK—The council of the Village of Tavistock has adopted a scheme for waterworks submitted by F. W. Farncombe, C.E., of this city. The estimated cost is $22,000, and will provide fire protection sufficient to meet the requirements of the underwriters for the whole of the village. The supply, which will be drawn from overflowing wells in the east side of the town, will be abundant and suitable both for fire and domestic purposes. The pumps, which will be run in conjunction with the electric light plant, will have a capacity of one million gallons per day, with a pressure of 120 pounds in the [illegible].

Quebec.

MONTREAL—The incorporation of the National Hydro-Electric Company, with a capital of $1,000,000, makes one more electrical company which will seek a market in Montreal. Mr. Henry Miles is the president of the new corporation, and Mr. Louis Gosselin the secretary. The Carillon Falls, on Ottawa [illegible] 5 miles from Montreal, will be the [illegible] of the power. This point, which is a [illegible] one in the rush for power development, was noticed in the report of the surveyors for the Georgian Bay canal, who considered that 148,000 horse-power could be developed, of great value, owing to its proximity to Montreal.

MONTREAL—The Grand Metis Power Co. will locate a large new plant in Montreal.

MONTREAL—Another attempt is to be made to convert the immense water power possibilities of the River St. Lawrence into an electric development proposition. The promoters of the scheme are the Canadian Light & Power Company, of which Mr. E. A. Robert, of this city, is the head. Application has been made to the Government at Ottawa for authorization to build dams across the river near Coteau, at the head of the rapids, and at the entrance to the picturesque Cedars. Works involving the expenditure of from $15,000,000 to $20,000,000 are projected by the Canadian Light & Power interests, in addition to those already under course of construction at the foot of Beauharnois canal. The plan adopted by the company was prepared by Messrs. White & Co., of New York, and was elaborated upon and considered by many [illegible] eminent American engineers, including Professor Williams, of Ann Arbor, [illegible] and Mr. Noble, who was largely instrumental in preparing the scheme for the [illegible] Company, farther up the river. The [illegible] understood, will provide for the [illegible] use to half a million horse-[illegible] reach of Montreal. It is [illegible] ess the water flow of the [illegible] rapids by the erection of [illegible] ng the north and south [illegible] nce, providing for the [illegible] by leaving two large [illegible] down which the passenger [illegible] rs may come on their way [illegible] the seaboard. The first [illegible] by the engineers, be built a short distance below Coteau, and will be 6,500 feet in length. [illegible] 17 feet, and the maximum [illegible] per hour. The chute [illegible] t the top and will have [illegible] at present. Remedial [illegible] the expenditure of many [illegible] the current brought about by the [illegible] f the river and to render the [illegible] f the channels above and below [illegible]

Coteau chute is just below the foot of Lake St. Francis, elaborate dams and other works will be built, should the company's plans mature, to take care of the winter and spring ice jams that characterize these seasons of the year. The second canal, or chute, will be built, it is projected, at the head of the Cedar rapids. This will be double the length of the Coteau chute, or 13,000 feet, to provide for the drop of 34 feet at this part of the river. The width of the structure will be the same as the upper one, with the same depth of water, and nearly the same current. The latter, however, decreases as the water flows down and reaches a normal speed at the foot of the chutes through the widening, or "flaring," of the canal at the foot. Montreal navigation men are not going to allow the Canadian Light & Power Company to proceed with their plans of damming the Coteau and Cedar rapids without strenuous opposition.

MAGOG, QUE.—An electric light and power plant will be constructed here, costing about $100,000. Engineers, T. Pringle & Son, Montreal.

The National Hydro-Electric Co., Montreal.

The National Hydro-Electric Co. will make use of the old Carillon canal in the development of their power. This canal was constructed many years ago by the Imperial Government, and for some years has fallen into disuse, the water being diverted through the new canal, which was built but recently, costing the Government $659,960. It is on the regular ship route of the proposed Georgian Bay canal, forming part of its system.

To be used for power development, the old canal will have to be excavated to some extent. Engineers estimate the cost at $250,000. The bottom of the canal consists of rock, shale and limestone, which can be removed by steam-shovel or dredge without blasting. This rock, however, will be solid enough for foundations for the power house, gates and sluices.

The water power passing through this gateway will have all the head of the great storage lakes in the Upper Ottawa. From the source of the Ottawa to Montreal there is a fall of 1,065 feet. Surveyors on the Georgian Bay canal made the following statement concerning the water power on the Ottawa: "The first power will be located at Point Fortune, near Carillon. The present low water head at the Carillon dam is 13½ feet, which, at a discharge of 17,400 cubic feet a second, is capable of developing 19,300 electrical horse-power. After the canal is constructed there will be concentrated here the fall of the series of rapids above, making a head of forty feet, which, with a regulated discharge of 43,950 cubic feet per second is capable of developing 148,000 electrical horse-power.

The Ottawa river has a basin of 56,000 square miles, and the largest lake connected with its head waters is Lake Temiskaming, which has an area of 115,000 square miles.

National Transcontinental Railway Shops, Transcona, Man.

The water supply for the new shops at Transcona is ready to be turned on as soon as the reservoir has been completed. The company has been at work on this project for several months, as it was necessary to pipe the water from a point on the Red river, and the necessary piping had to be installed, together with the reservoir and pumping plant. Also it was necessary to provide for a sewage system, and this is now being arranged with the City of St. Boniface. In the interval the pumping plant has been completed and tested.

The pumping plant is one of the most compact units of its kind in the west. After considerable deliberation the Government decided to install internal combustion engines. It is estimated that for the present 1,000,000 gallons a day will be required for the shops, roundhouse and water tanks, and this capacity has been provided for in duplicate. The contract for the pumps and intake was awarded the Brydges Engineering & Supply Co., and they have completed their contract.

The plant is situated along the St. Mary's road, a mile and a half south of the city. It is a small concrete building on the river bank, and the intake pipe is well out to the centre of the river. Inside the building there are two high-speed pumps of 1,000,000 gallons capacity each, direct connected to two 50 horse power gas engines. Gas is supplied by duplicate producers of the latest type. The engines, pumps and producers were constructed by T. H. & J. Daniels, Stroud, England. The water is delivered through five miles of 12-inch piping. Similar engines, but with only half the capacity, have been installed for the C. N. R. Fort Rouge shops, and the Government Telephone Commission generates its electrical energy from a similar engine.

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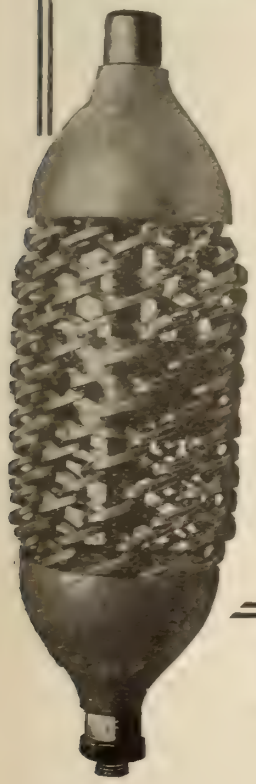

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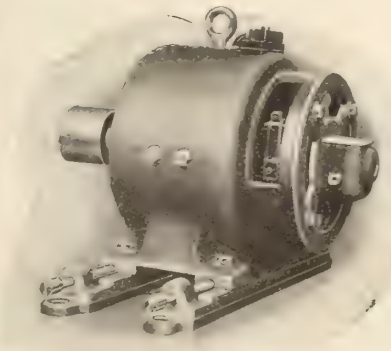

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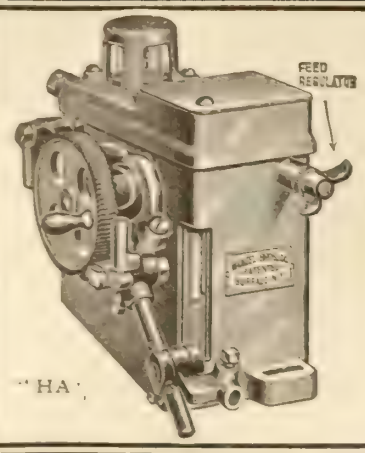

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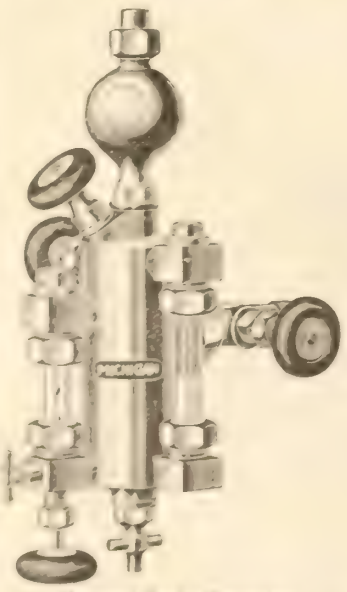

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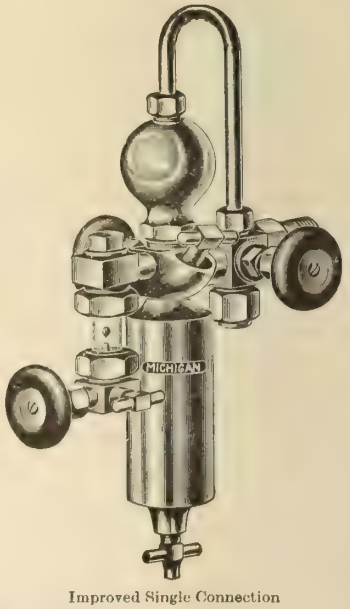

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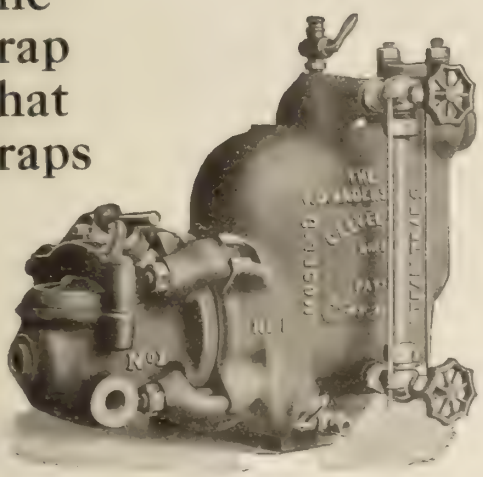
The Anderson Improved Steam Trap

Discharges the Water AND *Holds the Steam*

The Trap That Traps



It is all that its name implies—a trap for steam from which steam **never** escapes, and water of condensation **invariably does.**

The body is constructed of close grained iron with a valve which can be removed without disconnecting trap from pipes.

The valve and valve seat, of phosphor bronze, are simple in construction and easy of access.

The Anderson will deliver exhaust water against any back pressure of five pounds less than the steam pressure at the trap.

THE V. D. ANDERSON CO.

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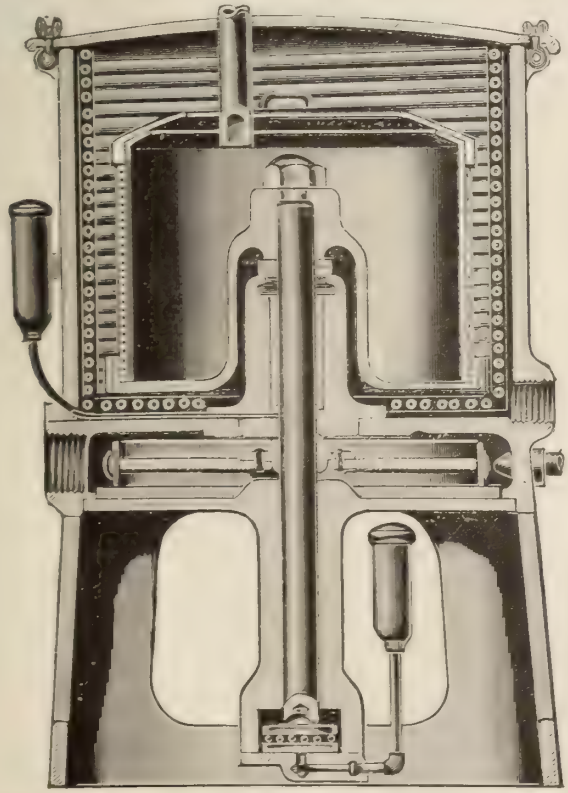

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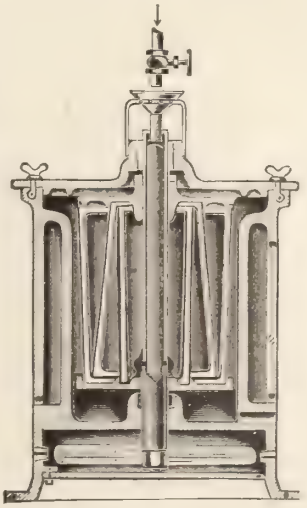
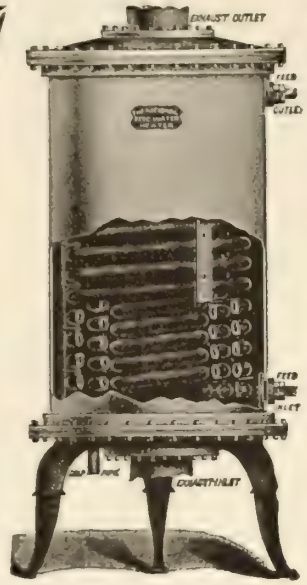


THE "NATIONAL" FEED-WATER HEATER



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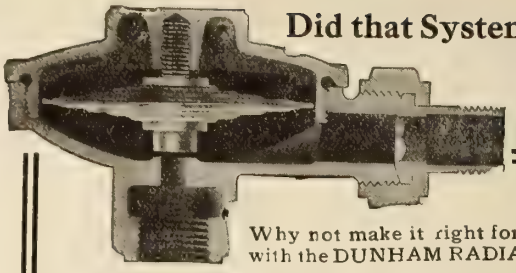

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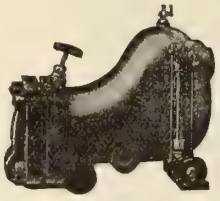

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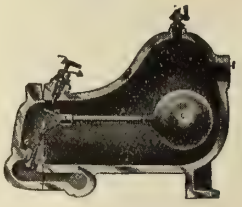

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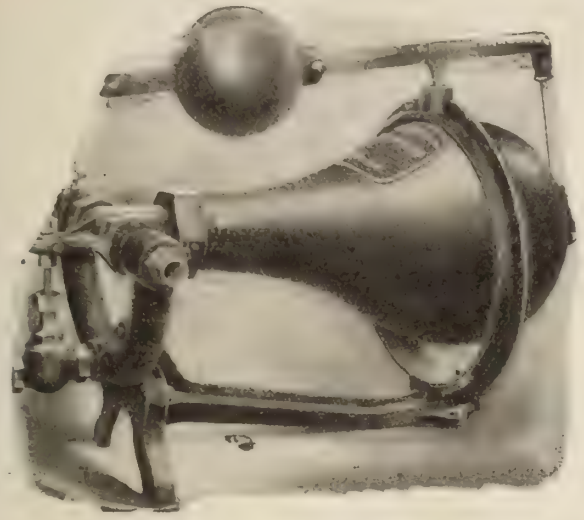

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BECAUSE Bundy Steam Traps mean Bundy Service.

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BECAUSE A Bundy Owner is a Satisfied Owner.

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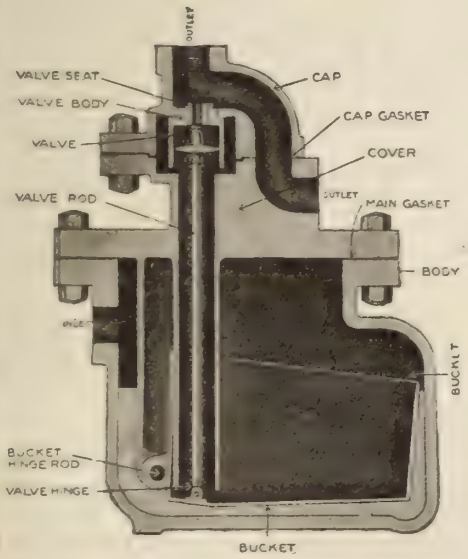

If the valves in your steam traps are leaking steam, and they probably are; if you have to take the time and trouble to take the trap apart to get at the valve, and the leak is 1/8 in. and your pressure 75 lbs., you are saying good-bye to at least 275 lbs. of coal every 9 hours. Why don't you buy

Strong Steam Traps

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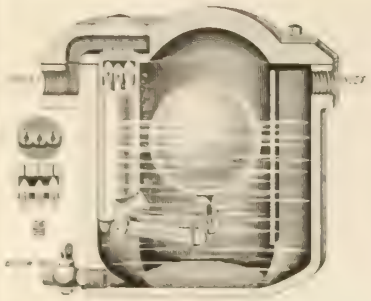

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STEAM TRAP

There are THREE VALVES in this Tra

ONE VALVE discharges the accumulated condensation in steam lines where the flow is normal.
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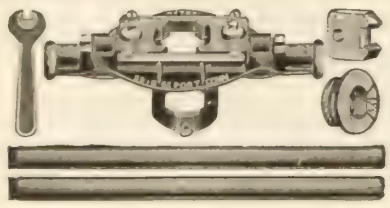

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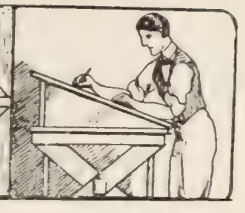

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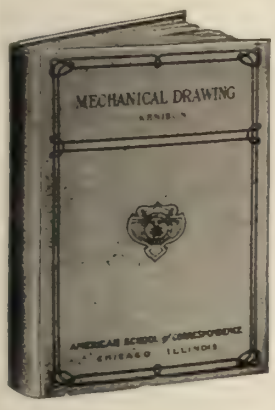

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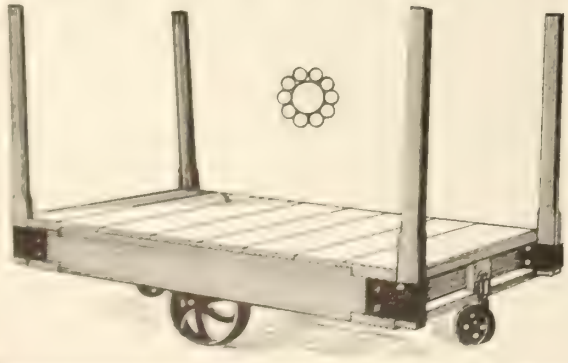

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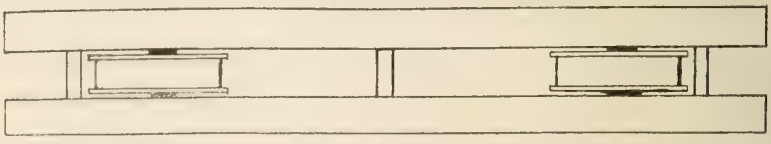

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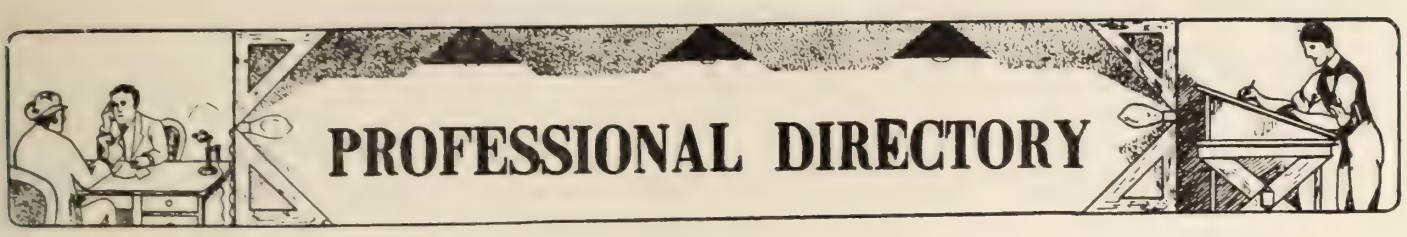

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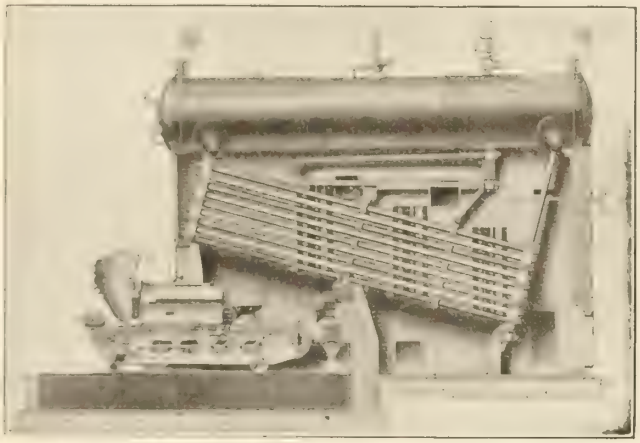

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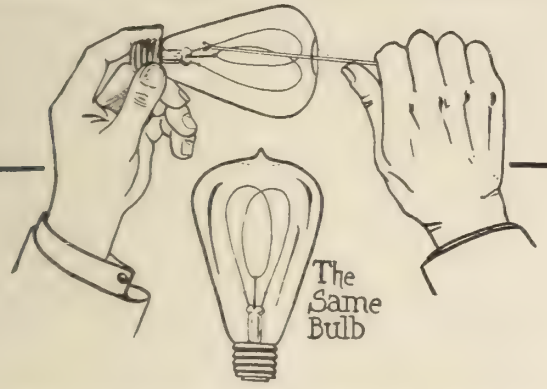

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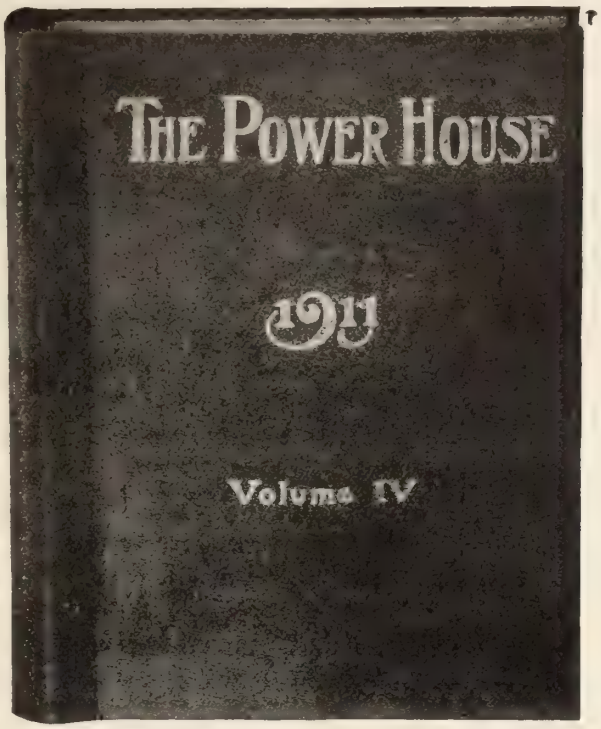

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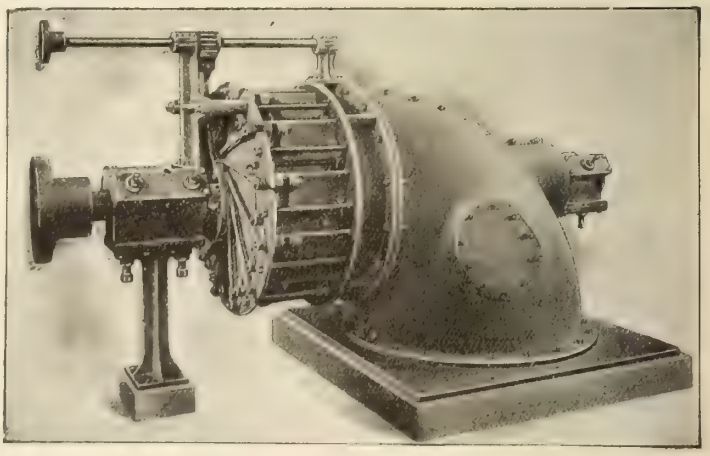

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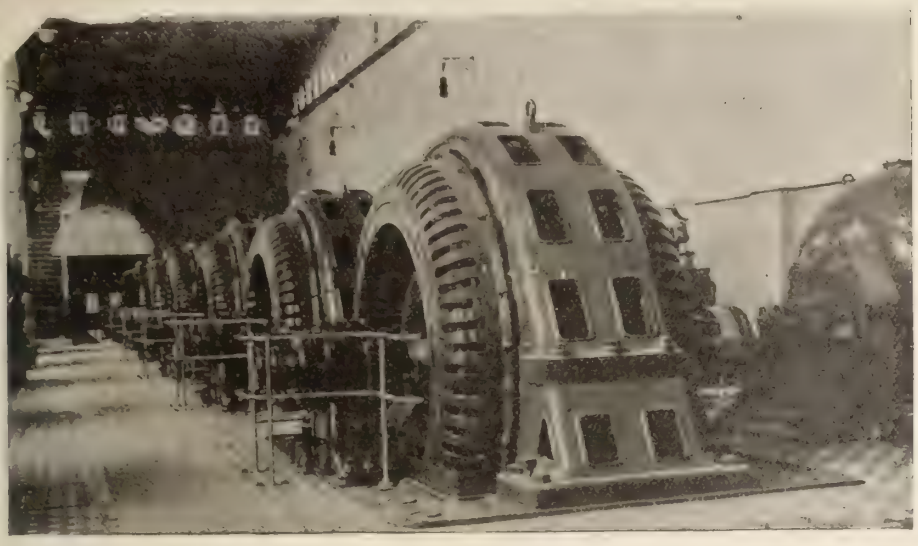

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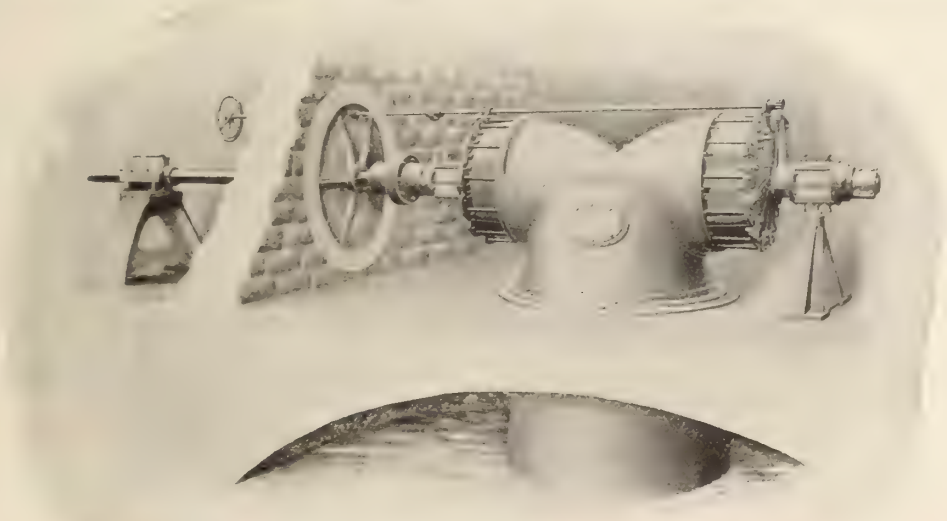

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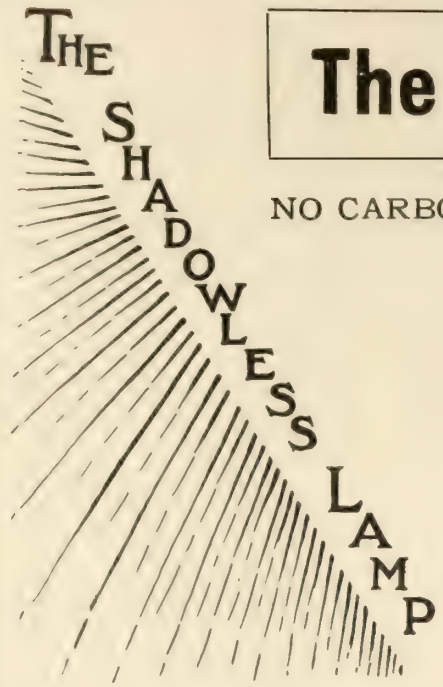

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SEAT MADE TO LEAK (See Note 'A' Below)

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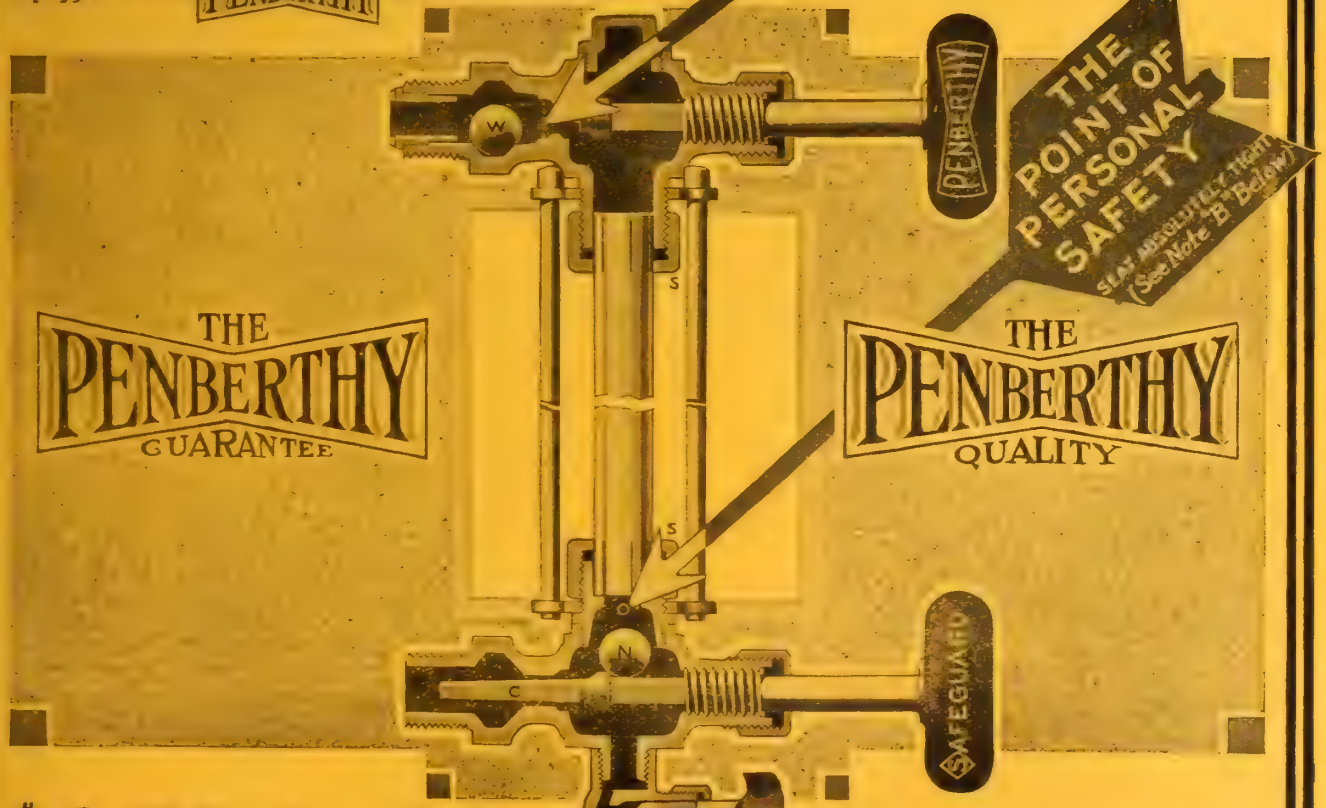

THE POINT OF PERSONAL SAFETY
SEAT ABSOLUTELY TIGHT (See Note 'B' Below)

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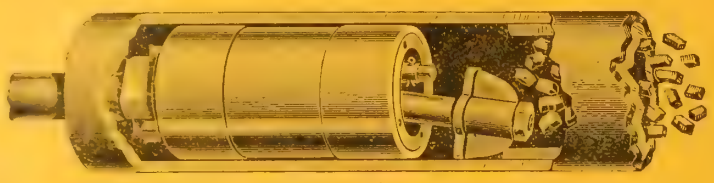
NOTE B—The lower seat is made absolutely tight and when glass breaks the ball seats instantly and NOT A DROP OF WATER AND NO STEAM ESCAPES to injure anyone.

MANUFACTURED BY

Penberthy Injector Co., Limited - - Windsor, Ont.

THERE are probably more devices and schemes for removing or preventing scale than for any other power plant purpose—yet boiler scale is still with us.



The Dean Removing Scale from the Tube of a Water Tube Boiler

And coal is still wasted by the lining or covering of scale on boiler tubes—which is about as sure a non-conductor of heat as you can find.

This because the "scale preventers" don't prevent and the "removers" don't remove.

That is, they don't do the job thoroughly, if at all.

And it's just for this reason that the **Dean Boiler Tube Cleaner** appeals to practical engineers.

The Dean operates on a principle that compels thoroughness.

It will remove pound after pound of scale from boilers that have been "cleaned" by other processes or methods.

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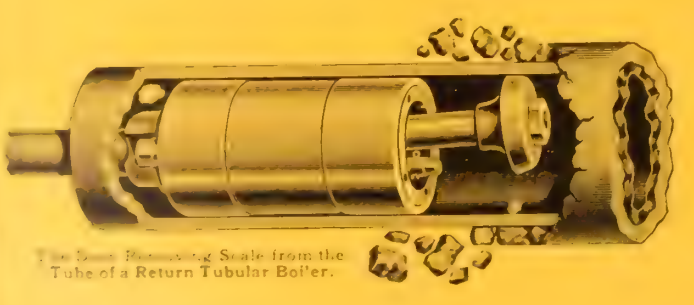
Therefore we know it will pay us to send you a Dean Cleaner with no strings attached to it.

The thing for every progressive engineer to do right now is to read and take up—

Our Trial Offer To Engineers



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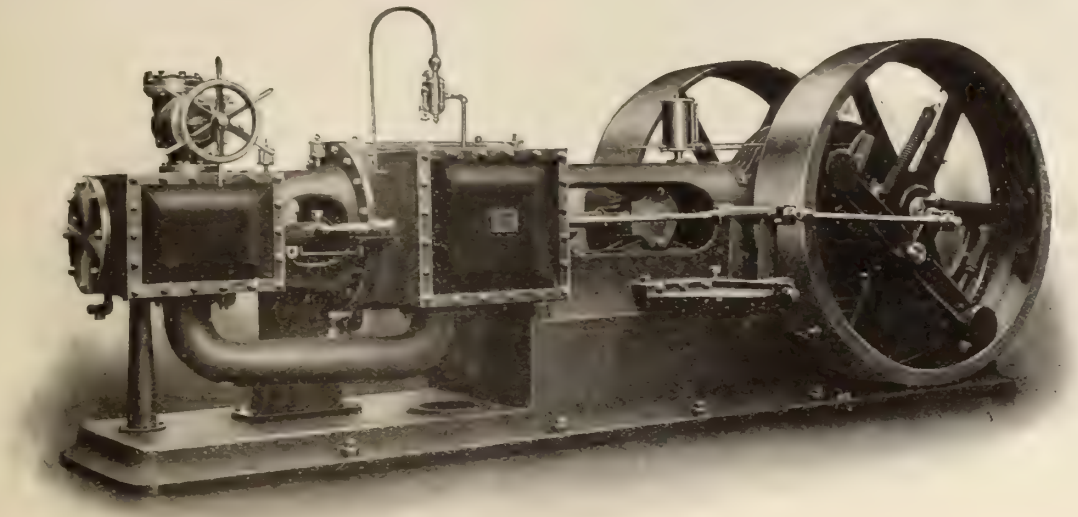

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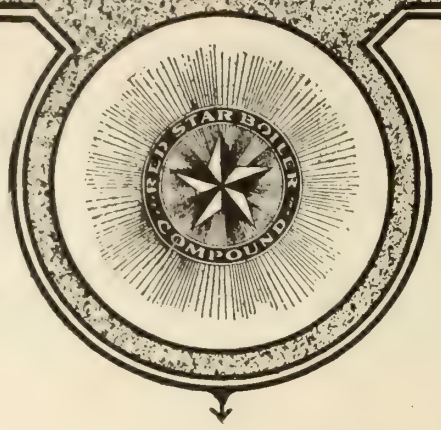

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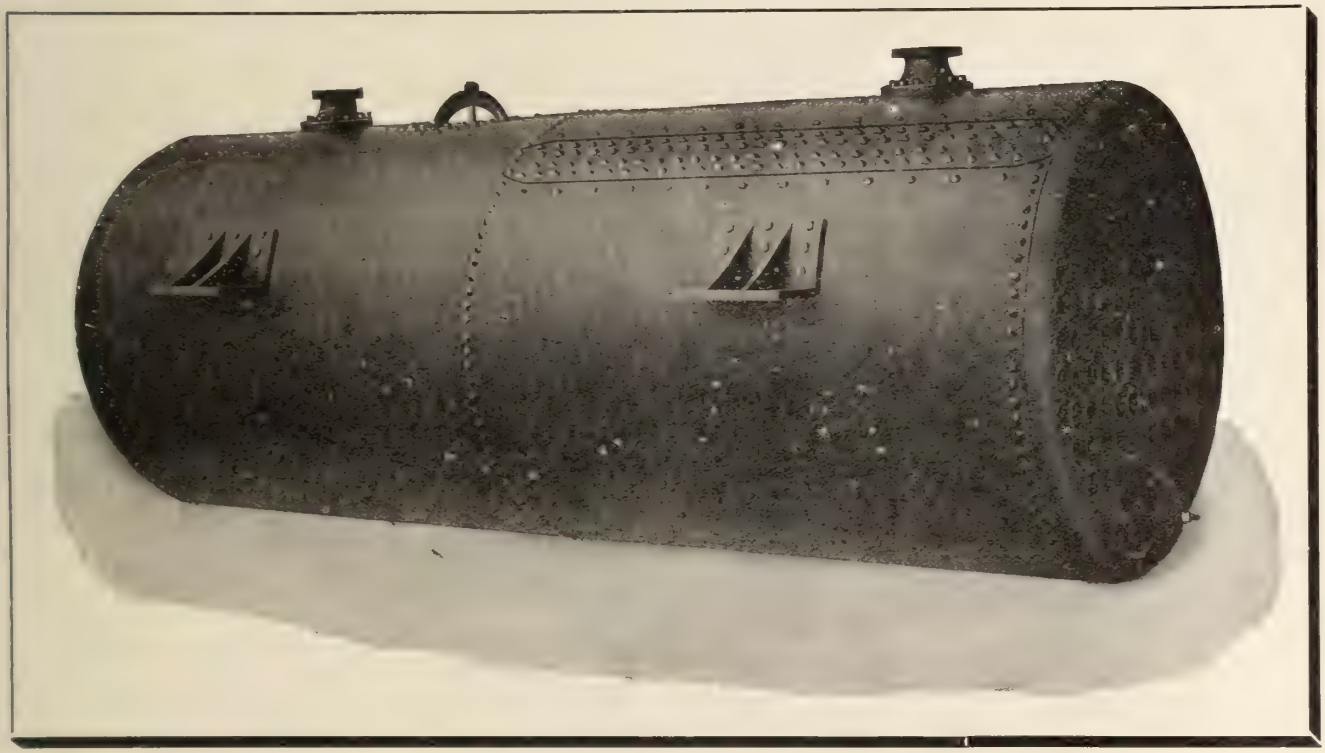

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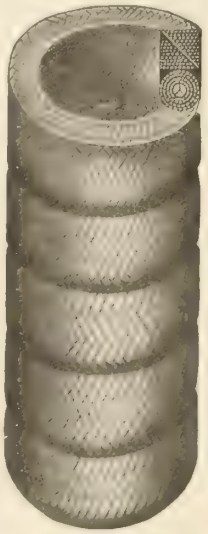

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1/16 inch.

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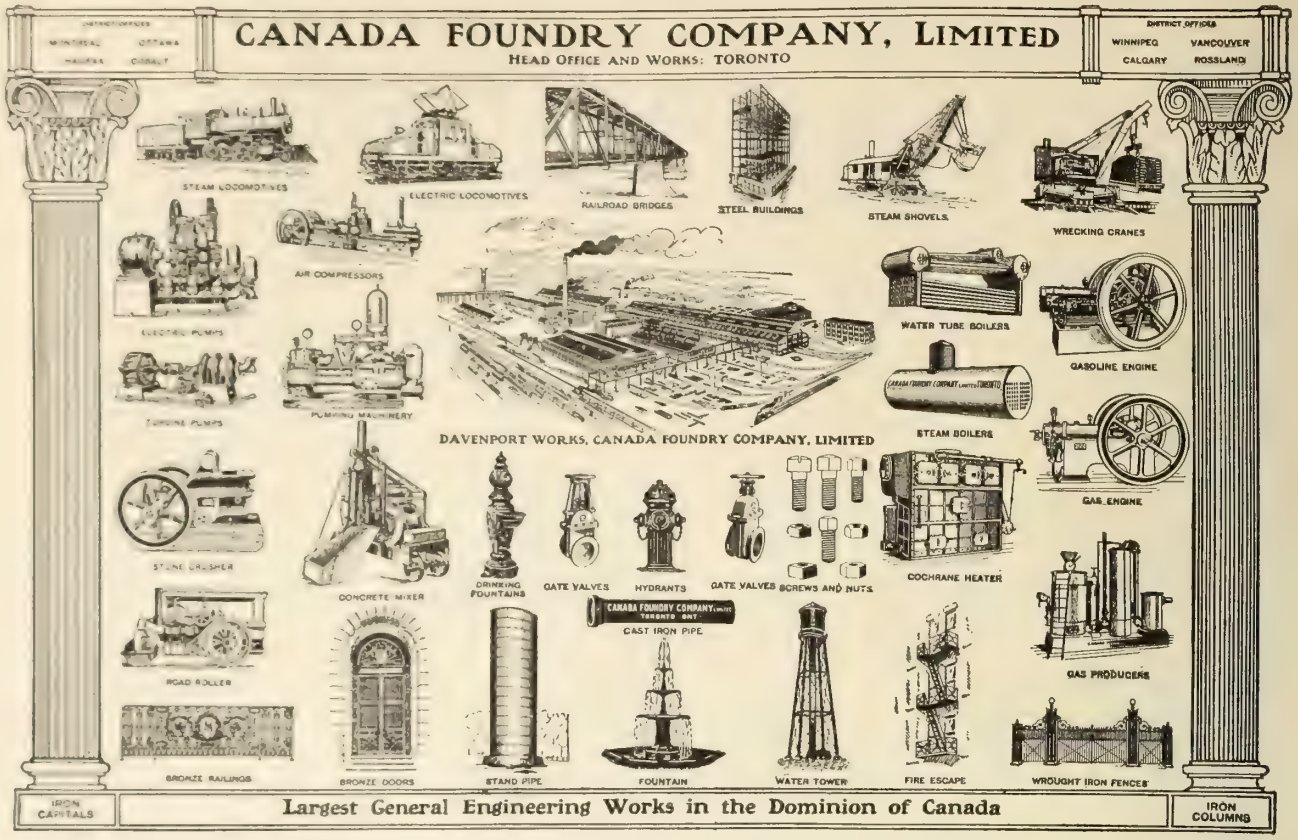

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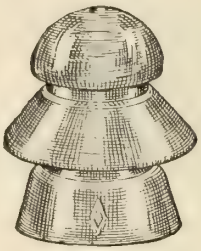

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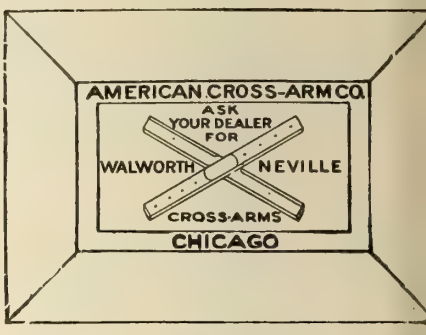

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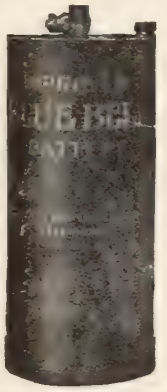

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LOSS BY SCALE

By Using
The Dearborn Treatment

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DEARBORN TREATMENT not only economizes in fuel but **prevents waste time, boiler corrosion,** and **repair bills. It will prolong the life of your boilers.**

Send us a gallon of feed water. We will analyze it and let you know cost of this HIGH GRADE TREATMENT made especially for your plant.

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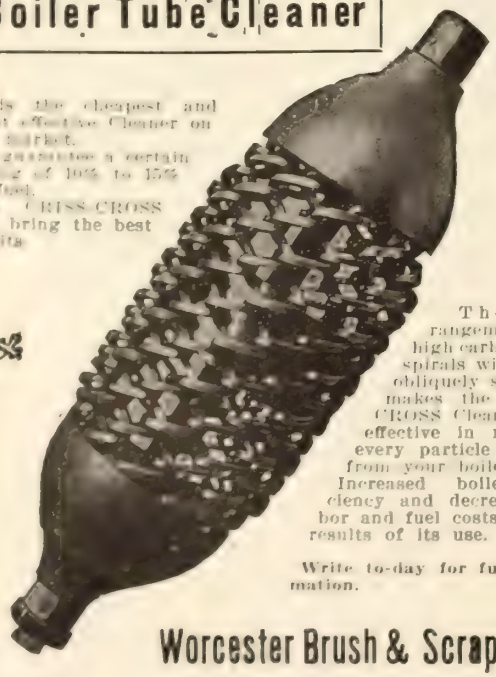
Criss Cross
Boiler Tube Cleaner

It is the cheapest and most effective Cleaner on the market.
We guarantee a certain saving of 10% to 15% in fuel.
The CRISS-CROSS will bring the best results

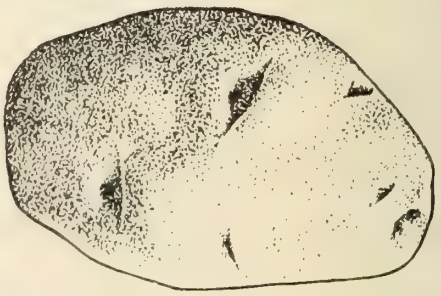


The arrangement of high carbon wire spirals with sharp obliquely set edges makes the CRISS-CROSS Cleaner most effective in removing every particle of scale from your boiler tubes. Increased boiler efficiency and decreased labor and fuel costs are the results of its use.

Write to-day for full information.

Worcester Brush & Scraper Co.
Dept. P WORCESTER, Mass., U.S.A.

Potato Scale Boiler Cleanser



Repeat orders prove the efficiency of this superior boiler compound. It will absolutely remove all scale from your boiler. It is guaranteed not to injure boiler tubes, shell or connections, and will prevent your boiler from foaming.

Remove your scale in an economical way—our way is the most reliable and economical.

Put it up to the user—you will always find him satisfied.

Let us demonstrate its worth by a free trial—it will cost **you** nothing if **you** are not satisfied.

Send along a sample gallon of feed water for analysis, and we will fill your requirements.

***C. C. Snowdon,* Wholesale**
P. O. Box 1384 - - CALGARY, ALTA.

"ECLIPSE"

BOILER ENAMEL

A THOROUGH PREVENTATIVE OF THE FORMATION OF BOILER SCALE, PITTING, CORROSION, FOAMING, ETC., IN ANY WATER.

A New Principle

For many years chemists the world over have been analyzing boiler feed water and endeavoring to prepare a compound, based on the analysis of the water to be treated, which would prevent the formation of scale, and as far as we have been able to learn they have not been successful.

We Treat The Iron

In *Eclipse Boiler Enamel* we have a preparation which gives no heed to the class of water used, but in every case puts a filmy coating over the heating surfaces of the boiler, which makes it absolutely impossible for solid matter in any form to adhere to the iron. The scale-forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler in the form of a soft, soapy mud which will not burn or blister and is most readily blown from the boiler.

Our Proposition

The following letter, which accompanies every trial shipment of ECLIPSE BOILER enamel, speaks for itself.

Winnipeg, ————

Messrs. ———— ————,

Gentlemen:—We have shipped you this date—Bbl. Eclipse Boiler Enamel, which, when used according to directions contained in our booklet, must give you **entire satisfaction** in your plant, otherwise you will not be required to pay for same. We leave it to your own sense of fairness to see that **Eclipse gets a square deal**; under these conditions we are sure of the result.

Eclipse Boiler Enamel is guaranteed to be absolutely harmless to boilers or their fittings.

Being harmless, it is slow in its action on old scale, but is deadly sure.

Yours very truly,

Send for our booklet to-day

W. W. CARRUTHERS

388 Edmonton Street, WINNIPEG, Man.

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

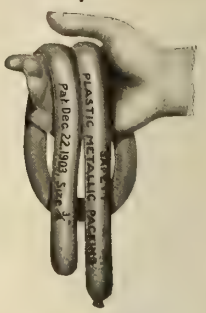
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

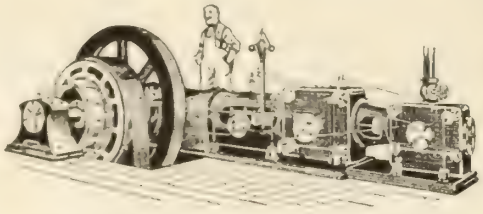
Practically Frictionless



Sold on APPROVAL

HEAR! HEAR! What do you think of it now?

This is the way we guarantee your engines and pumps to work for ONE YEAR when packed with



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ONCE USED—NEVER CHANGED

AGENTS WANTED

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c o C. W. SPENCER & CO., 55 St. Francois Xavier Street, Montreal, Quebec.

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Mill, Factory and Steamboat Supplies

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BEAR STEAM PACKING for Piston and Valve Rods. Its advantages over other steam packings are perfect elasticity, and the fact that it reduces friction to the lowest possible limit, hence a great saving in engine power, or a proportionate saving in fuel.

BEAR PUMP PACKING. High pressure, suitable for any class of pumps or hydraulic machinery, has given every satisfaction up to 2,000 lbs. pressure per square inch.

"VINCO" BALATA BELTING, made of the ***best cotton duck,*** and pure balata. Stocked in sizes from 1½ to 14 inches.

We also carry a full stock of all other Engine Room and Machinery Supplies, and we are specially equipped for the making of all sizes of ASBESTOS GASKETS.

See us before placing your order.

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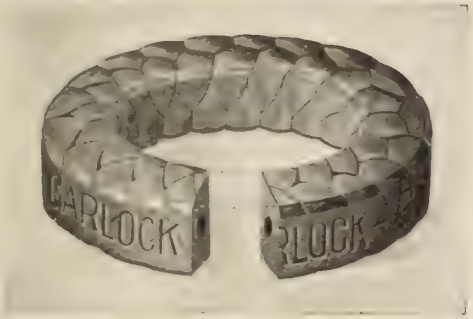

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Spiral Form

Specially adapted and guaranteed to do the work required on cold water pumps, elevator cylinders, cold oil and brine.

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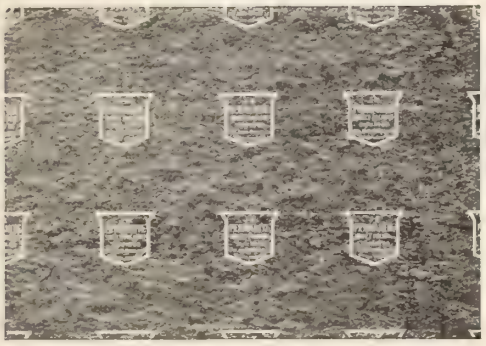
Pioneers in the Packing Business

J-M Permanite Sheet Packing

Makes Joints Permanently Tight



That is one thing a rubber packing cannot do, especially for high pressure and superheated steam conditions.

Rubber will lose its elasticity

Rubber will soon soften and go to pieces under high pressure.

And your same old leak troubles will worry you again.

Not so with J-M Permanite Packing.

J-M Permanite is made of the highest grade of pure Asbestos.

It will stand the highest temperature and the greatest pressure.

In addition to that, especially prepared compounds are added, which make its resiliency and pliability almost equal to that of the best rubber sheet packings.

So, J-M Permanite adjusts itself to any joint, even or uneven.

And once in service, it lasts three times as long as most other packings.

Has the all-important advantage of making a joint absolutely tight—permanently tight.

Never blows out — never burns out — never squeezes out. And it requires no following up.

J-M Permanite is the best packing for any and all pressures for steam cylinders, steam chests, steam and ammonia lines, acids, alkalis, and sugar solutions.

Try it—try it on the worst joints you can pick out.

Just see for yourself that J-M- Permanite really is a packing that requires no following up.

Write nearest Branch for Samples and Booklet.

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H. W. Johns-Manville Co., Limited

Mfrs. of Asbestos and Magnesia Products. ASBESTOS Asbestos Roofings, Packings, Electrical Supplies, etc.

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1178

"Everlasting" Blow-off Valves

LEAKS MEAN LOSS

Does your blow-off valve leak?

If it does you lose money. A leaky Blow-off Valve means extra fuel consumption without returns of steam pressure.

A leak may be small and escape your notice, but at the same time you are losing steam and money.

The "Everlasting" Blow-off Valves are guaranteed not to leak. Made in Semi Steel with Naval Bronze working parts. In Semi Brass with Top Bonnet of Semi Steel, giving Bronze to Bronze connection. In Solid Brass with working parts of Naval Bronze.

Made in screwed and flanged styles

Thousands of engineers have backed it up as the **PERFECT BLOW-OFF VALVE.**

Many railways in United States and Canada have adopted it as an absolute standard, and a dozen or more boiler makers consider it a necessity to a high-class boiler.

We are willing to take the verdict of any high-grade engineer as to its reliability and efficiency.

We also manufacture

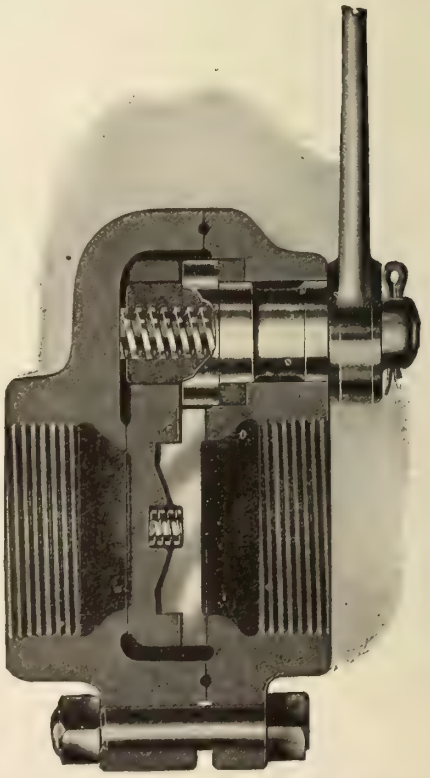
THE POPULAR

SCREWED
FLANGED
LONG TURN

BRAND

STANDARD
EXTRA HEAVY
SEMI-STEEL

CAST IRON FITTINGS



Standard Fitting and Valve Company, Ltd.

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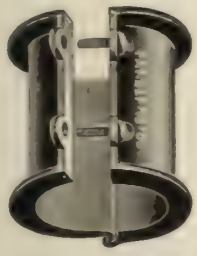
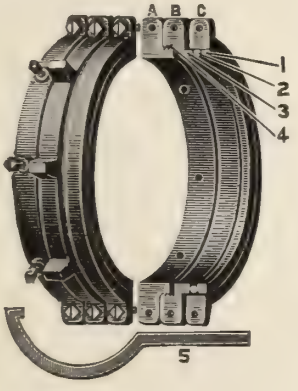
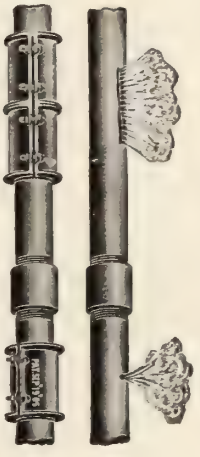
FOR EMERGENCIES LIKE THIS

EVERY ENGINE ROOM
SHOULD HAVE A FEW

Emergency Pipe Clamps







They are inexpensive and very effective in stopping steam or water leaks.

Thousands of these clamps are in use. Order now, so when the occasion arises you will have them on hand, as you will need them badly.

Skinner Valve
Reseating Machine

Stop Those Valves Leaking

SKINNER VALVE RE-SEATING TOOLS

Will pay for themselves on the first few valves saved without disconnecting from the pipes. Every plant using valves should have one. They are the best reasonably priced tools on the market; the cost of replacing two 2-in valves on the pipe represents the price of the Tool.

The Canadian Fairbanks Co., Limited

Fairbanks Scales—Fairbanks-Morse Gas Engines—Safes and Vaults.

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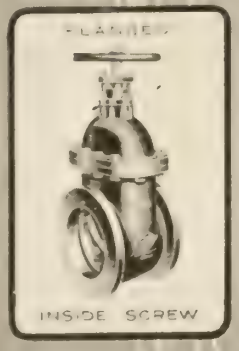
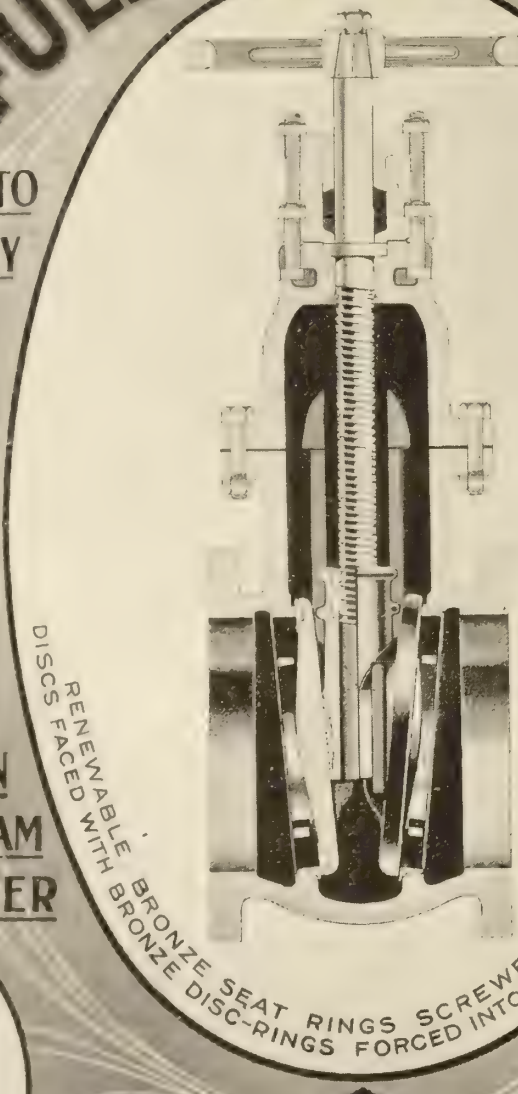
TYPE K
IRON BODY
FULLWAY VALVES.

OPENS CLEAR TO FULL CAPACITY OF PIPE

CLOSE EQUALLY WELL IN UPRIGHT OR INVERTED POSITION

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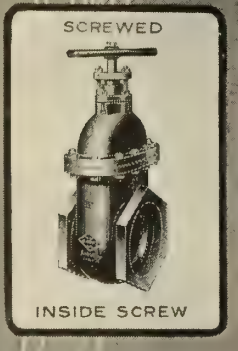

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GATES CLOSE POSITIVELY WITH BALL BEARING ACTION

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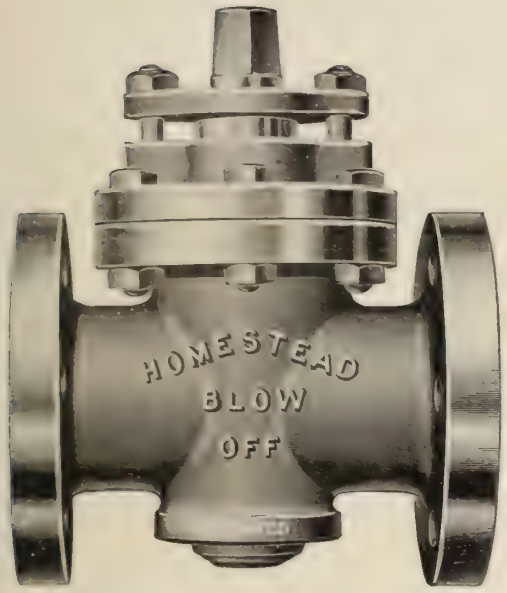

Homestead Valves are Quality Valves

A quarter turn—just a slight twist of the wrist—closes or locks the *Homestead*. A quarter turn back opens it wide. It being free from friction, long life and the maximum of service is assured. This valve cannot jar open—when you lock it, it stays locked. The seats are perfectly protected from wear both when closed and when pressure is passing through them. *Every valve* is hand ground to a perfect fit and tested before for shipment. They are absolutely leak-proof under any steam, air or hydraulic pressure. *Homestead Valves* are giving satisfaction throughout the entire world, under the most severe conditions. Just try one if the valves you are now using are weak in some essential point. The many superior points of *Homestead* Straightway, Three-way and Four-way Valves fully described in our catalog. Have a copy?

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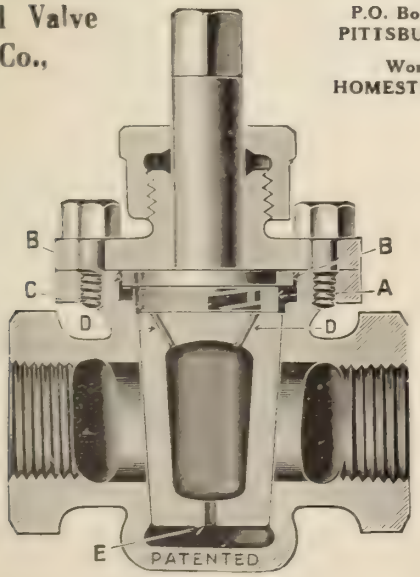

Outside View of Standard Valve for 125 pounds working pressure

Inside View, showing Leather Disc for Hydraulic Service

Nelson

Bronze Swing Checks

Simple.

None like it.

No *Joints.*

No *Plugs.*

Body cast in *one piece.*

Bearing for clapper *cast solid* in body.

Only *five parts* in steam valve, with bronze disc; (the leather disc and nut are added for hydraulic work).

The clapper bearing swings easily, almost *without any wear or friction.*

Free ball-and-socket movement in disc *compels perfect seat.*

Full 100 per cent. flow when open.

Works well in *any position,* vertical, angle or horizontal.

All parts renewable and interchangeable.

Well balanced proportions.

Strong.

Standard, for 125 pounds working pressure, *tested to 250 pounds.*

Extra Heavy, for 300 pounds working pressure, *tested to 800 pounds.*

Design, Metal, Workmanship, same high grade as in Nelson Gates and Globes.

You can't find a better.

Showing th Bronze Disc Mechanism

Nelson Valve Company
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Nelson Valves are made in the Gate, Globe, Angle and Check types, in all sizes, of Iron, Bronze, or Steel, for all pressures, for any service.

If your dealer hasn't complete stock, write nearest Nelson office—WE WILL TAKE CARE OF YOU.

Save Fuel — Save Labor — Save Money

and quit worrying about keeping the water in your boilers at the right level by installing a

BICE REGULATOR

It is inexpensive, fully guaranteed; is practically indestructible, and costs nothing to operate.

Regulates one or any number of boilers, maintaining, under all conditions, a constant, uniform, supply of water in each boiler. Simple in design and easily attached, it requires no attention and does away with the Pump Governor on Single Boilers.

Our FREE booklet tells all about the "BICE" and gives

30 REAL REASONS

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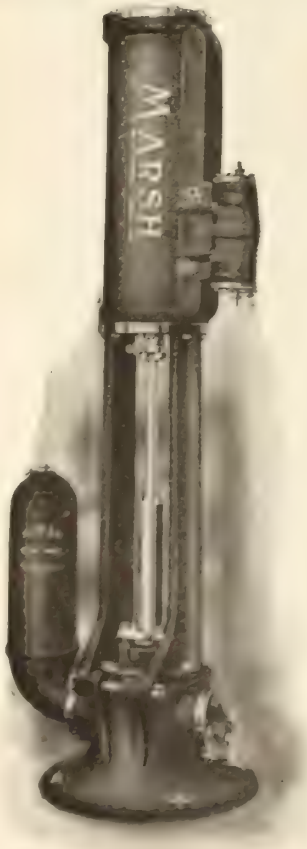

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Are you sure that you are obtaining the maximum capacity from your well with a minimum steam consumption?

The distinguishing feature of Marsh Deep Well Pumps is high efficiency combined with low cost of up-keep. They are equipped with a self-governing steam valve which admits just enough steam to do the required work. They are made with hinge base, affording easy access to the well pipe at all times.

AIR LIFT SYSTEMS

We also manufacture a line of steam and power driven air compressors which combine durability with highest efficiency. The Marsh Steam Valve is especially adapted for air compressor service.

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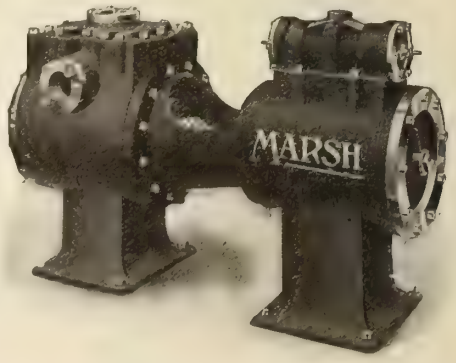

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Counts in

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Bishops
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will withstand the highest Steam Pressures and all variations of temperature.

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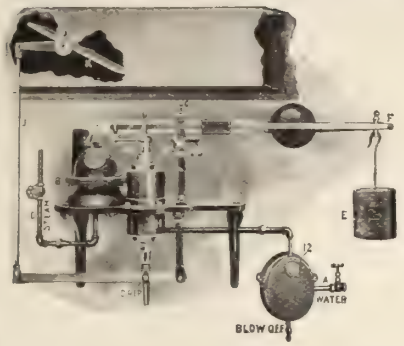

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Stillman-Carmichael Damper Regulator.

The SAVING effected in FUEL by the installation of this Regulator will vary from 5 to 18% and the first cost is very small.

It will REGULATE High and Low pressure STEAM BOILERS, Blowers and Pumping Engines.

One Regulator will govern one or more Boilers. It will close or open wide the damper or dampers on a variation of ONE POUND of STEAM.

We furnish these Regulators subject to 30 days' trial.

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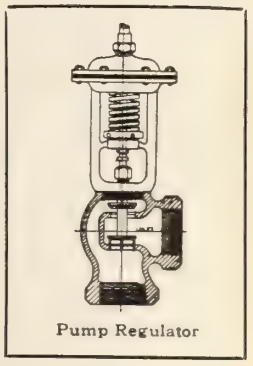

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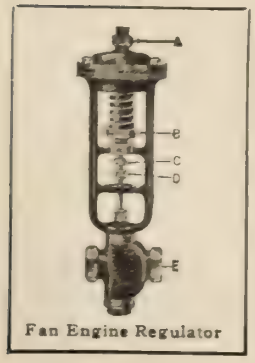

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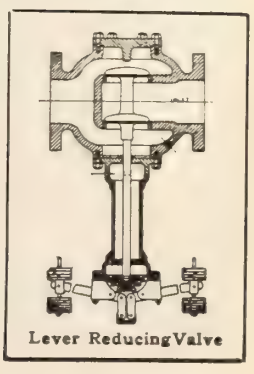

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CARELS DROP VALVE STEAM ENGINES

for HIGHEST ECONOMY and RELIABILITY

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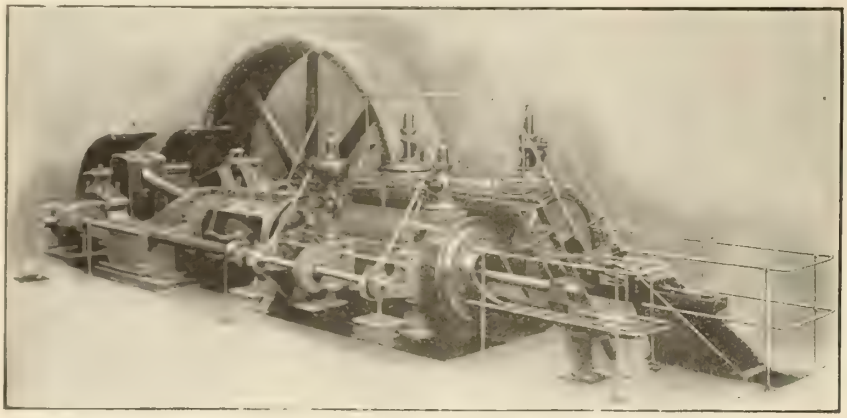

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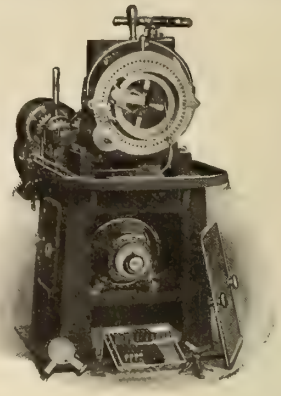

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Constant speed motors used and various speeds obtained by lever control,

Triple compound spur gears cut from solid castings.

Oil pump direct connected, no belting.

No loss in friction, self-contained work done on the spot.

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S. DYMENT, President **BARRIE, ONT.** E. J. GRAVES, Managing Director.

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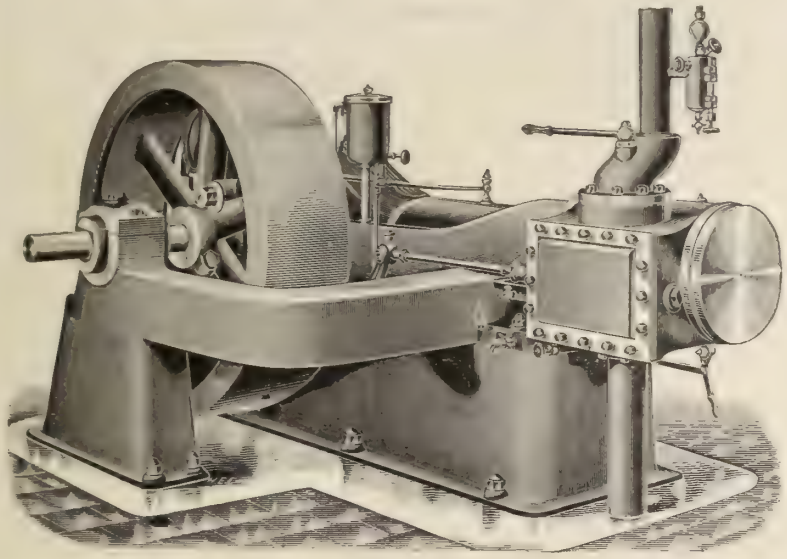

In sizes up to 125 horse-power, the outboard bearing of our side-crank engines is connected to the frame by a wing, keeping the bearings perfectly in line.

These engines are built on the interchangeable system, and duplicate parts are kept in stock, ready for shipment on receipt of order

They have our latest improved governor and oiling system and are strictly high class in every respect.

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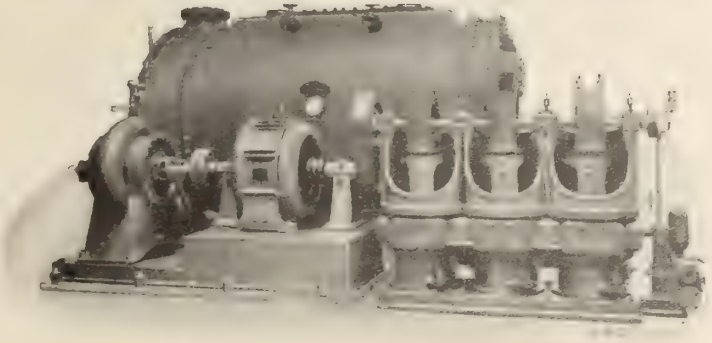

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Designs

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OF EVERY DESCRIPTION

BAROMETRIC LOW LEVEL JET or SURFACE

All on the Counter-Current Principle

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Equal in workmanship to the Belliss Engine.

GIVE UNEXCELLED SERVICE.

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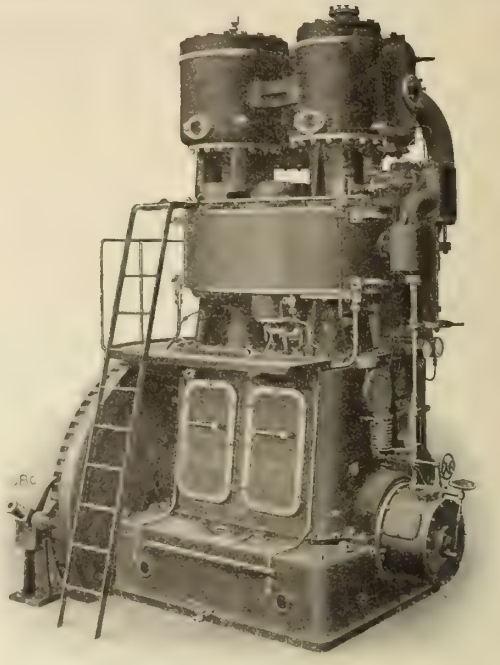
NO HOT BEARINGS.

Economy and Efficiency set a new standard in Air Compressor practice.



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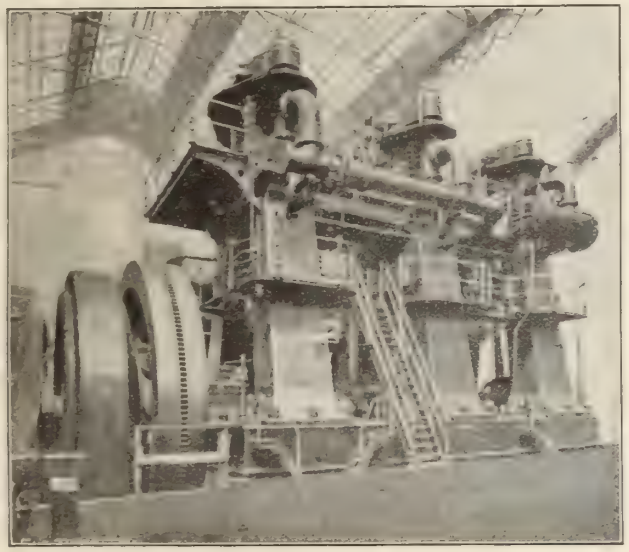
The Engine, of which cut is shown below, was at the Glasgow Exposition, and its bearings were lined with Magnolia Metal. We are informed that it was the only Engine that ran continuously during the Exposition, without having to shut down because of hot boxes, whereas other large Engines at the Exposition, in the bearings of which the manufacturer used metals of their own make, had continual trouble.

John Musgrave & Sons are among the greatest Engine builders in the world.



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Gentlemen,—In reply to your enquiry, we beg to inform you that we have used a very large amount of Magnolia Metal for our bearings, and have found the same to give excellent results. We have fitted all our Electrical Engine bearings with this class of metal, including the Glasgow Engines of 5 000 I.H.P., the largest bearing of which is 32 in. diameter, 64 in. long, and we have every confidence in recommending it as a splendid metal for wearing and anti-friction qualities. Yours truly,

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Flatter and praise, commend, extol their graces,
Though ne'er so black, say they have angel's faces.
That man that hath a tongue, I say, is no man
If with a tongue he cannot win a woman.
—*Two Gentlemen of Verona*

Possibly Women May be won with a tongue experienced in the art of flattery. But women and love have nothing to do with the matter in hand. It requires something more than flattery to win the position attained by

HARRIS HEAVY PRESSURE

Its reputation is built on a firm foundation, for in the manufacture of this metal the raw material is carefully selected and NOTHING BUT THE BEST IS GOOD ENOUGH, that is why we can guarantee every pound.

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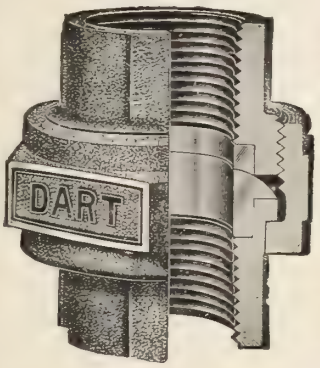
have bronze on each face of the joint and when drawn together form solid bronze to bronze connections. That's why DART UNIONS never rust or corrode at the joint, and can be disconnected and connected as often as desired.

Joints are quickly made with DART UNIONS whether the pipes are in or out of line. The perfect ball shape seat permits it.



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We guarantee DART UNIONS to do all we claim for them and we will replace with two unions any one found defective.

DART UNIONS are sold by nearly all dealers and are made in screwed, flanged, tee and elbow types, male and female.

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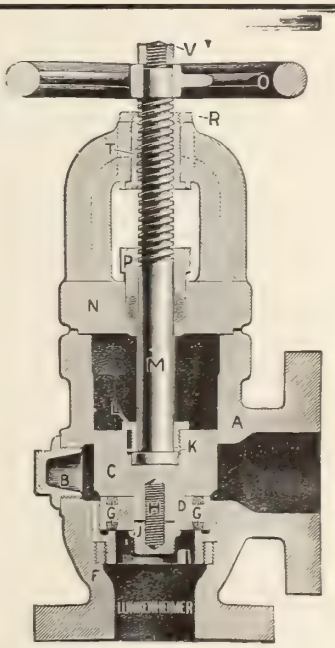

Are guaranteed for 250 pounds working pressure. The cast iron used has a tensile strength of 25,000 pounds per square inch, and the bronze used contains a high percentage of copper and tin. One of the principal advantages in the design of these valves lies in the construction of the seat and disc which provide SELF-CLEANSING SEATING SURFACES, and any scale or dirt that may lodge on the face of the seat will positively be washed off before the disc is firmly seated, thereby insuring a PERFECTLY TIGHT VALVE.

The disc is DOUBLE SEATED and can be REVERSED or RENEWED when worn. The SEAT is also RENEWABLE, as also are all other parts of the valve subjected to wear.

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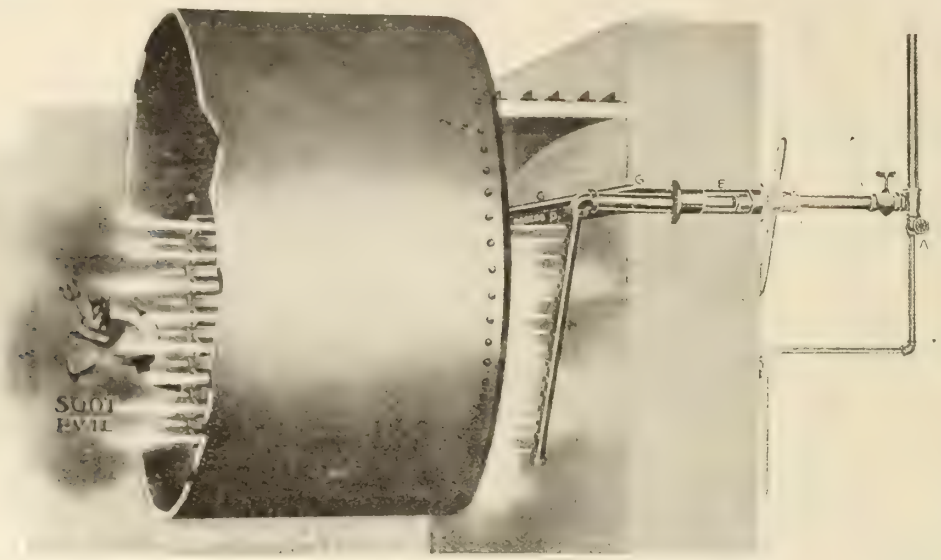
First Aid to the Soot-Sick Boiler— The Vulcan Soot Cleaner



The Vulcan Installed on a Fire Tube Boiler.

The Vulcan for Fire Tube Boilers

Manufactured under Patents Nos. 89841 and 95665.

A movable blow-pipe with a number of nozzles so placed that no tube will escape thorough cleaning.

Pipe swings in a half-circle across the entire tube area and discharges jets of dry steam directly into every tube—always blowing with the draft.

It is operated by means of a handle and a swivel on the outside, and when not in use the blow-pipe is drawn into a recess in the rear wall away from the heat.

The steam enters the tubes with full force.

These cleaners will be installed or sent to any responsible firm on 30 days' trial. They are guaranteed to accomplish satisfactory results; are guaranteed against defects in workmanship or material for one year; they are further guaranteed to save their cost in six months or less.

THE importance of soot removal needs no explanation. You know that soot prevents absorption of the heat supplied by the coal, permitting valuable heat units that should reach the feed water to escape up the stack.

You know that a small boiler with clean tubes is equal in steaming ability to a large boiler with tubes choked up with coal-wasting soot.

And knowing this you try to blow out the soot with some boiler straining, man-killing front-end hand-blower which, blowing against the draft, can never accomplish thorough cleaning—

Despite the trouble it causes, the shut downs, the night work, etc.

Put aside the old-fashioned inferior cleaning device.

Put in the modern system of soot cleaning, the Vulcan System.

Put it in at our expense. Try it 30 days Free.

You'll be surprised at the results; the ease with which it cleans; the thoroughness.

The fireman or engineer, instead of shirking the job, will do it gladly.

The whole operation of cleaning the entire boiler takes two minutes; the operation consists of turning a valve to let in steam.

This trial costs you nothing, puts you under no obligation.

On the other hand we positively guarantee the Vulcan to pay for itself in coal saving inside of six months.

So this trial gives you the chance to save 1-6 the cost of your Vulcan before you pay us a cent.

Certainly a proposition that it will pay you to accept whether yours is a small plant or a large.

The sooner you get it started in your plant the sooner will you save on your coal and repair bills, the sooner will you get 100% value from your boiler.

Why not act NOW?

The Vulcan for Water Tube Boilers is Another Marvel of Efficiency

Our Free Booklet

"Economical Steam Production" goes into complete details about Soot Removal; shows why soot is costly, why it should be removed completely; and shows how the Vulcan accomplishes this result. Shows the Vulcan installed in various types of boilers, and explains our guarantee and Trial offer. Send for your copy to-day.

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Please send us, without charge, your book---ECONOMICAL STEAM PRODUCTION, and your proposition.

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Here is the Stored Energy

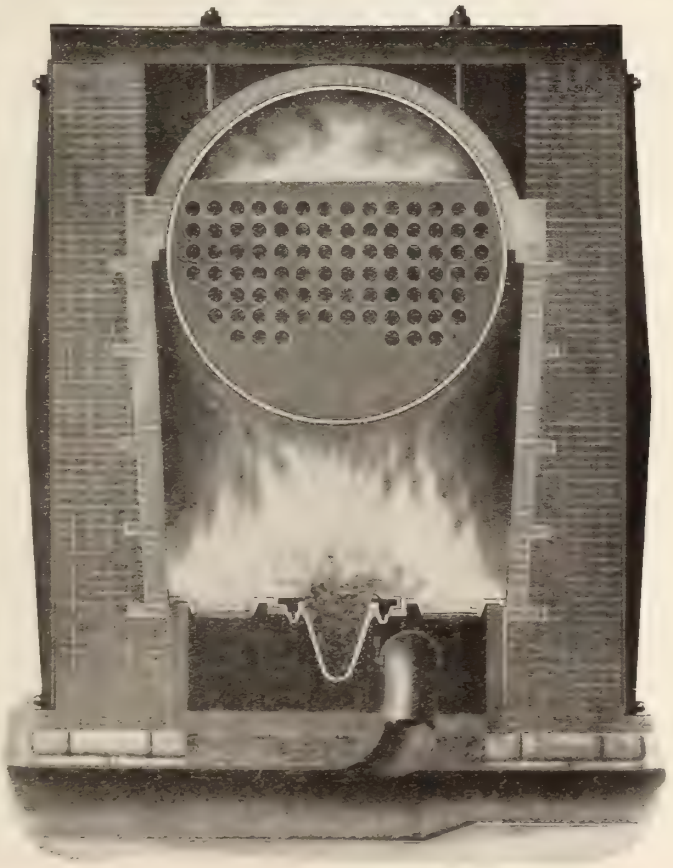
It has cost you dollars to get it there!

The Jones Stoker watches over the coal pile.

Are you utilizing it with economy or indifferent to its consumption?

Is it converted into steam, or does a large percentage leave the stack in volatile gas and smoke?

With the Jones underfeed system of firing, the green or uncoked coal is fed beneath the coked or burning bed of fuel, consequently the volatile gases formed must pass through the intense heat above before reaching the stack, therefore cannot escape unconsumed.



The ability of the Jones Underfeed Stoker to utilize the heating value in the fuel, together with its automatic regulation of air and coal supply by the steam pressure, produces the highest obtainable degree of economy, resulting in a net saving in fuel of 15 to 20 per cent. over ordinary hand firing.

The PREVENTION OF SMOKE ordinarily is an expense. Instal a Jones Stoker and it becomes a profit-making investment.

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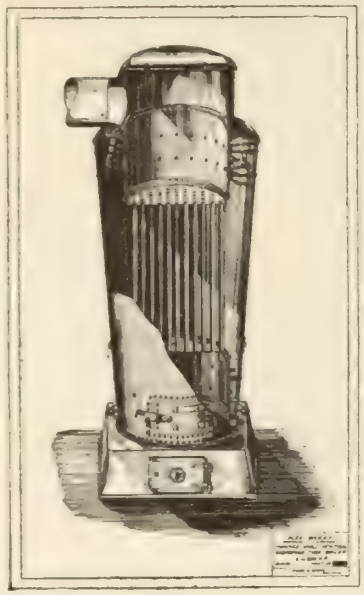
BOILERS



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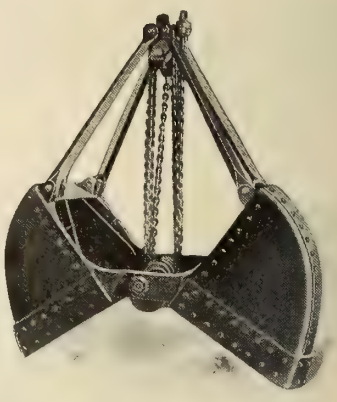

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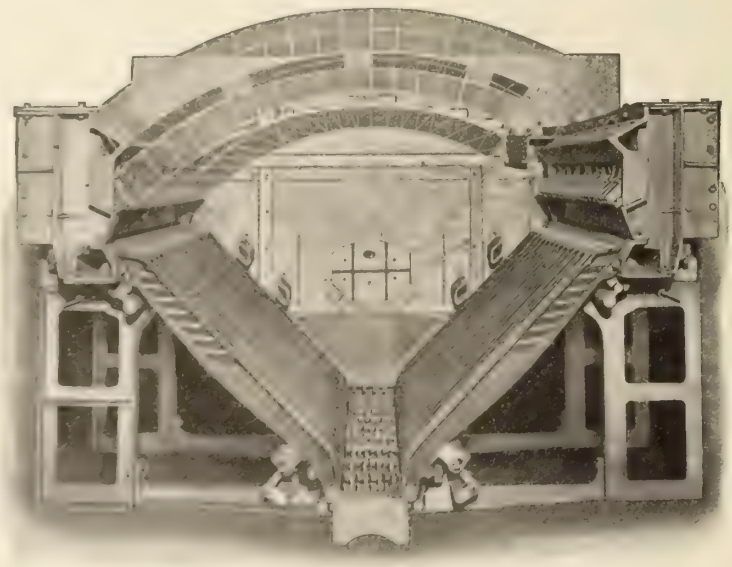

Burns Cheap Fuel and reduces labor in the boiler room.

DETROIT STOKER (Rear View)

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IT IS WORTH HAVING

Our new bulletin 107 gives official tests of a 12,000,000 gallon turbine pump driven by a 750 h.p. triple expansion steam engine and of a 5,000,000 gallon turbine pump driven by a 400 h.p. induction motor.

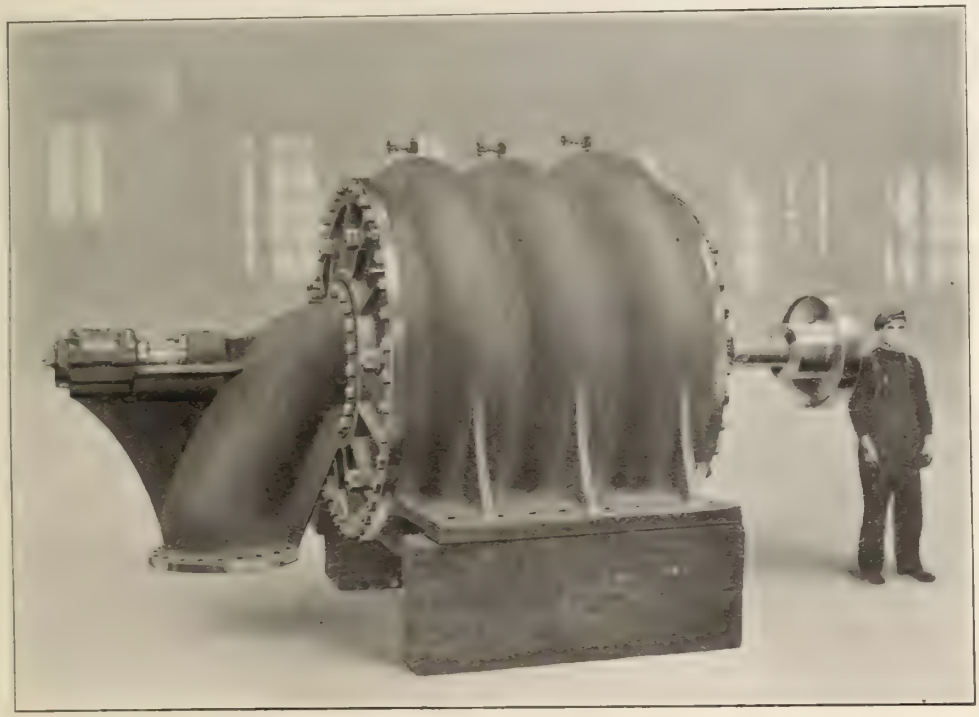
These tests were not made in a laboratory and the conclusions are not theoretical.

They were conducted under actual working conditions by disinterested experts on behalf of the purchaser.

These are the only tests which have any interest or value to the public.

The performance of the engine driven unit is particularly worthy of attention because, prior thereto, it was considered impossible to deliver water with commercial success against high heads by these means.

Authentic details of steam consumption and of the duty are given in the new bulletin 107.



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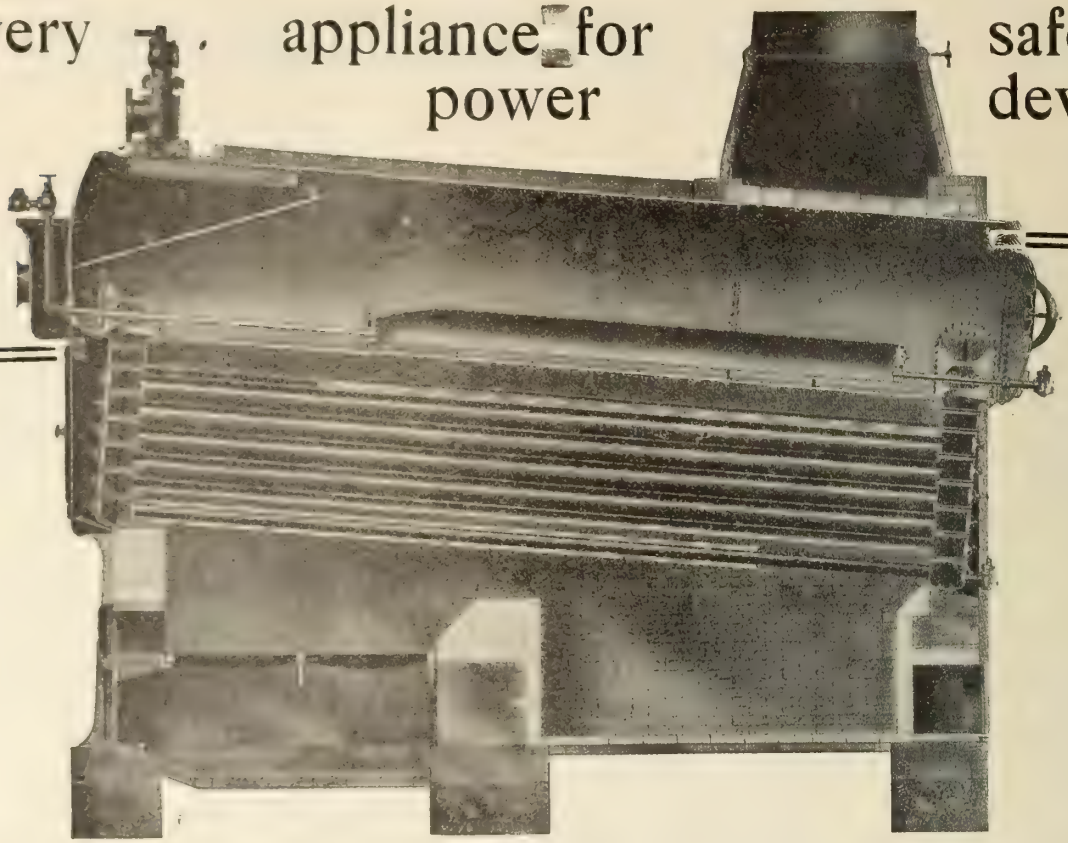
The HEINE SAFETY BOILER has every appliance for safe power development



The Heine Safety Boiler

has proved its worth and has been installed in many of the world's best steam plants. It is a thoroughly modern boiler.

The HEINE type boiler absorbs more heat than others, and transmits it more certainly to the water.

The result is a dry steam with a minimum fuel consumption.

HEINE Safety Boilers are economical, lasting well under hard usage, and are equipped with a mud drum that effectively purifies the water, precipitating all scale and filth.

May we send you our descriptive literature of interest to every boiler user?

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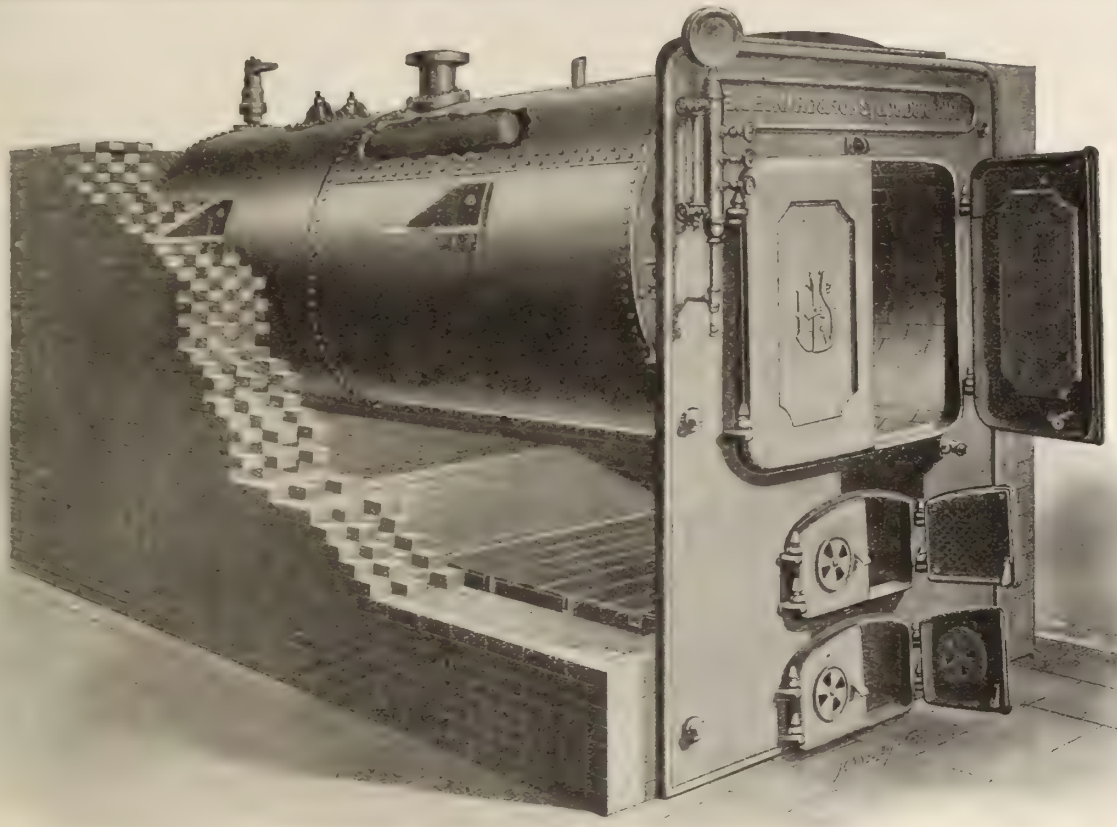

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We make High, Medium and Slow Speed Four-Valve Corliss Engines, High Speed Automatic Engines, Saw-mill Engines and Dairy Engines.

We also make a full line of Heaters, Retorts, Tanks, Pumps, Etc., Etc.

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GOLDIE CORLISS STEAM ENGINES

Are Being Installed in Canada's Largest and Most Modern Power Plants.

SOME OF THE REASONS WHY ARE:

The excellence of Material and Workmanship and their good general design.

The Frame is Heavy and Very Rigid.

They have Four-piece Main Bearing with wedge adjustment on both sides.

The Outer Bearing is Ring Oiling.

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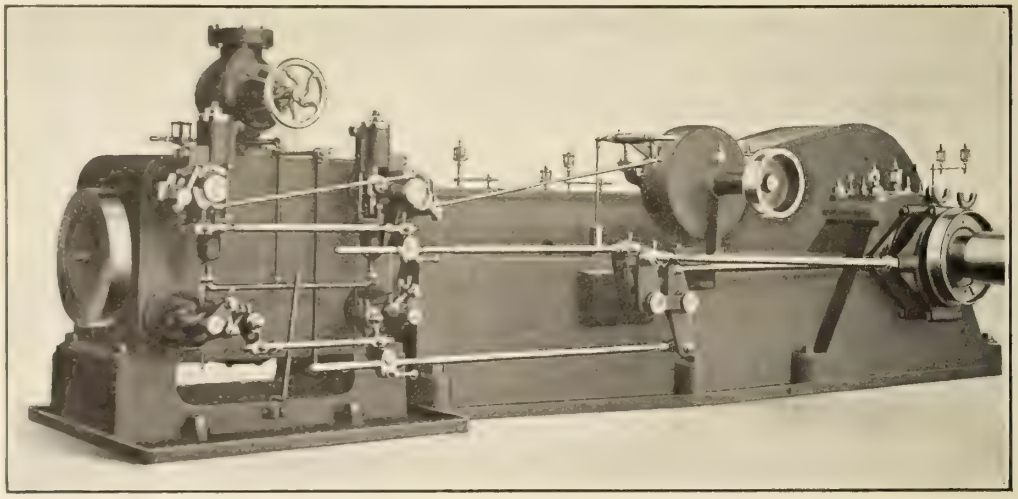
Connecting Rod is one Solid Forging.

Very close Regulation



VALVES are double ported, ground to size, seats lapped and edges of valves and ports are planed with special planer.

HEAVY DUTY GOLDIE CORLISS STEAM ENGINE

The above are a few of the special features which have made the GOLDIE CORLISS so popular among Canada's Power Users.

Our Engineers will be glad to go into details as to possible saving by installing your own plant.

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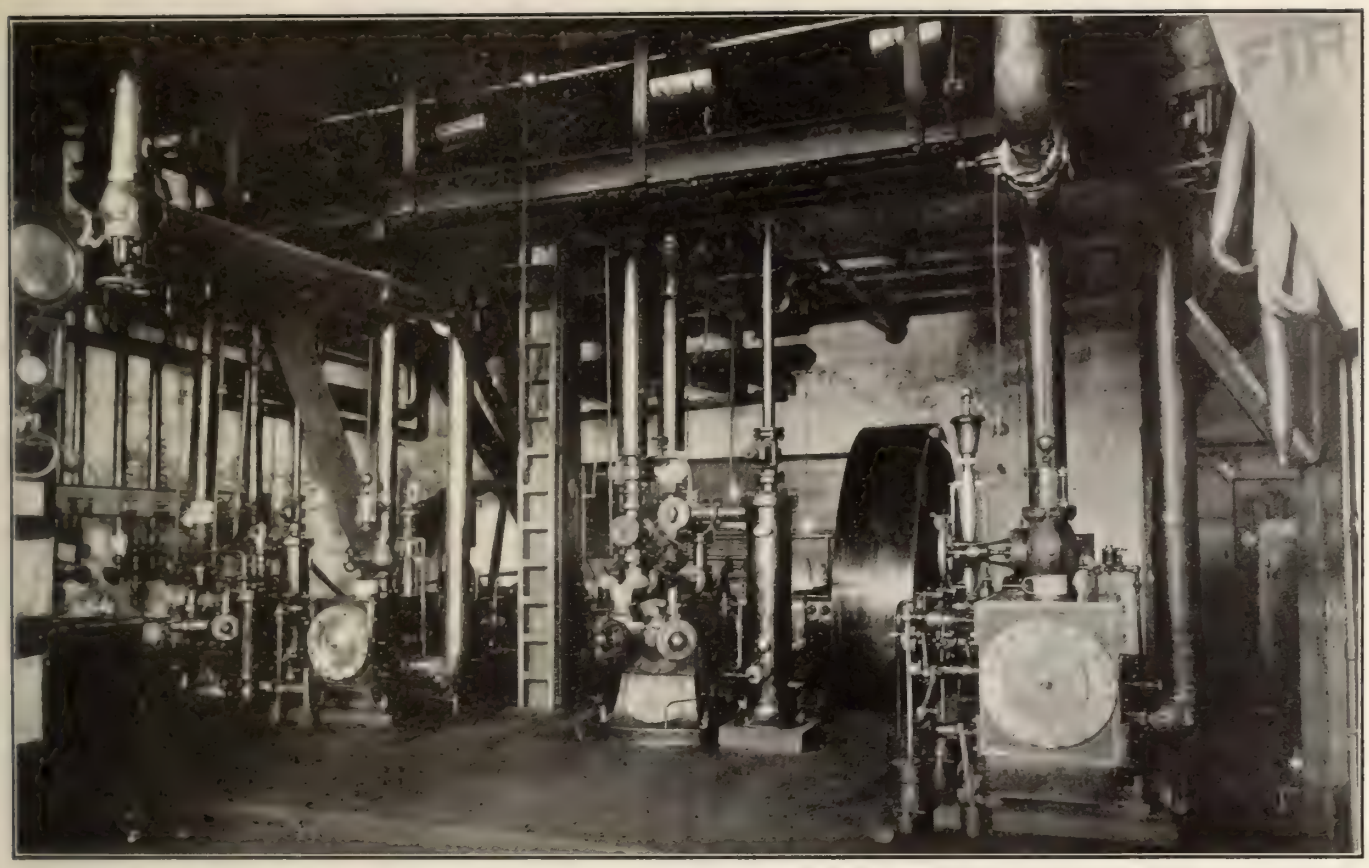


Fig. 1—Harris Abattoir—Engine room, showing 40-ton and 65-ton refrigerator units.

Power Plant Equipment, The Harris Abattoir, Toronto

The Public Requirement of an Abattoir or Packing House is That Absolute Cleanliness of Method, Equipment, Interior and Exterior of Buildings, Habits and Actions of Employees, be the Prevailing Conditions Under Which Work is Carried on. The Management Requirement is that the Power Plant on Which the Industry Depends for its Source of Action, be Kept in Such Perfect Condition of Repair and Tidiness, that the Risk of Breakdown and Delay is reduced to a Minimum. A Shut-Down in Summer in Plants of this Nature Means Invariably Considerable Loss, and in the Harris Installation It will be Noted, Not a Little Foresight Has Been Displayed as a Preventative.

THE power house and refrigeration plant at The Harris Abattoir, Toronto, is a good example of what such equipment should be, and the following account of it will doubtless be of interest.

As is only to be expected in a packing house where cleanliness is so essential, the engine room and boiler house present an extremely orderly appearance, and might well serve as a model to power plants in other fields.

Boiler Room.

Fig. 2 shows a general view of the boiler house, which contains a battery of three Heine safety boilers, constructed by the Polson Iron Works, Toronto. Each boiler is rated at 250 h.p., and fired

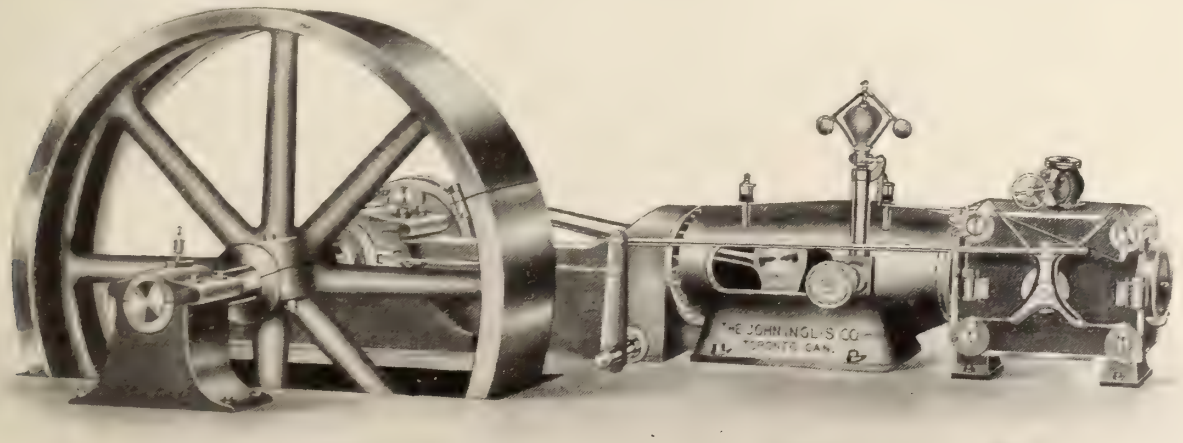


Fig. 7—Harris Abattoir—Inglis heavy duty Corliss engine, cylinder 24x48; 450 i.h.p.; 75 r.p.m.

by a Murphy automatic smokeless furnace, under natural draft. The fuel hoppers of the latter are filled by hand, and about 16 tons of Pennsylvania small coal are consumed every 24 hours, with two boilers only in service, which

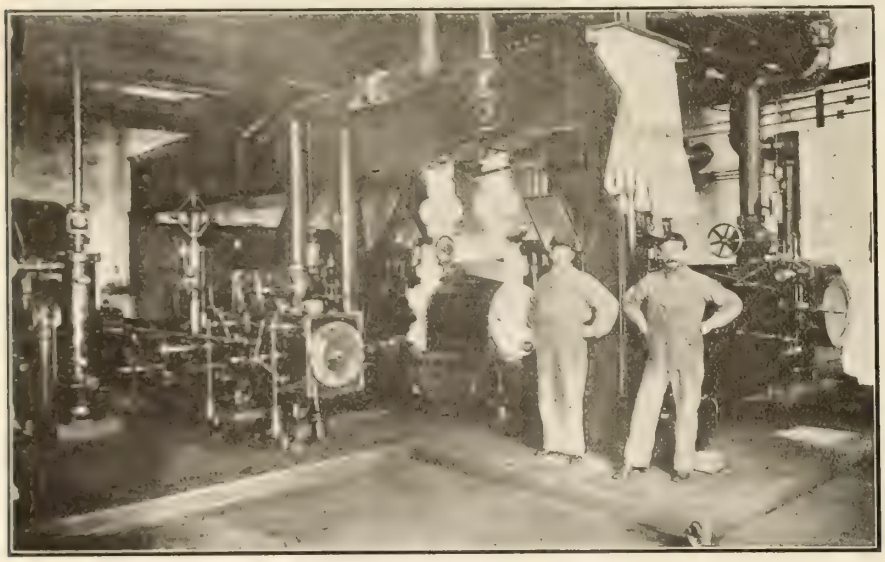


Fig. 1—Harris Abattoir Southwest corner of engine room.

is normal. Mr. W. R. Tyler, the general superintendent, considers this setting of boilers to be one of the most economical he has seen under operation in an experience of more than 20 years.

Each boiler is provided with two 3-inch Crosby safety valves, and with two water gauge columns. Precautions against breakdown are a noticeable feature; each boiler having two feed pipes, as well as two stop valves on the leads to the main steam header

Feed Water Apparatus.

The feed water passes through a Moffat open heater, 3 feet 6 inches diameter by 12 feet high. In it the temperature is raised to about 210 degrees before passing to two 10x6x12 inch. outside packed ram pumps, fitted with pot valves, and supplied by the Smart-Turner Machine Co., Hamilton,Ont. The check valve and delivery lines are in duplicate, as may be seen in Fig. 3. Both pumps are fitted with thermometers and water relief valves.

Steam and Exhaust Piping.

The steam piping throughout the plant is extra heavy, and is fitted with Crane's 250-lb. fittings, tongued, grooved and jointed with copper gaskets. Ample provision is made for expansion wherever necessary. The main steam header is 10 inches in diameter and is provided with an efficient separator, trapped to the feed water heater.

The engines all work non-condensing, and exhaust into a common exhaust header 12 inches in diameter, fitted with an oil separator.

About 75 per cent. of the exhaust steam is used in various parts of the general plant for evaporating and heating purposes; the remainder going to heat the boiler feed. The evaporating and heating condensation is handled by a double-cylinder 5x4x10 inches vacuum pump, made by the Martin Pump and Machine, Co., Toronto. This pump maintains a vacuum of 15 inches, and delivers the condensation to the feed water heater at a temperature of about 100 degrees. It is located in the pump room at the rear of the main engine room, where are also two other pumps of similar type and size. One of these is used for hydraulic purposes, delivering water at a pressure of 110 lbs., for use in the sausage-stuffing machines and elsewhere. The other pump is used for miscellaneous purposes, chiefly pumping the oil necessary in the various packing processes.

Engine Room Equipment.

Figs. 1 and 4 show views of the engine room, in which are three units (all single cylindered Corliss engines), each cross-connected to amonia compressors, made by the Linde British Refrigeration Co., Montreal.

Taking these units in their order, Fig. 1 shows on the left the engine used for driving the main shaft, from which power is distributed to different departments. This engine was built by the Laurie Engine Co., Montreal, and has a 14x28 inch. cylinder with Corliss valve gear. It develops about 100 h.p. running 75 r.p.m., and has a 14 feet flywheel, with 20-inch face, driving the main shaft by means of an 18-inch belt. The main pulley drives the shaft through a fricton clutch, so that in case of a breakdown or accident, the shaft can be quickly stopped. In addition to the shaft drive, the engine is cross-connected to a 40-ton ammonia compressor, but which was not in service at the time of taking the photograph.

The engine seen in the centre, Figs. 1 and 4, was also built by the Laurie Engine Co., and has a 16x36 inches cylinder. It is cross-connected to a compressor of 65 tons capacity. On the right of Fig. 4 is seen the largest single cylinder compressor unit in Canada. This 24 by 48 inch Corliss engine was built by the John Inglis Co., Toronto, and is equipped with their patent Corliss valve gear, which admits of extremely accurate adjustment.

The mere compression of a coil spring on the governor by means of a small thumb screw, allows the engine to be

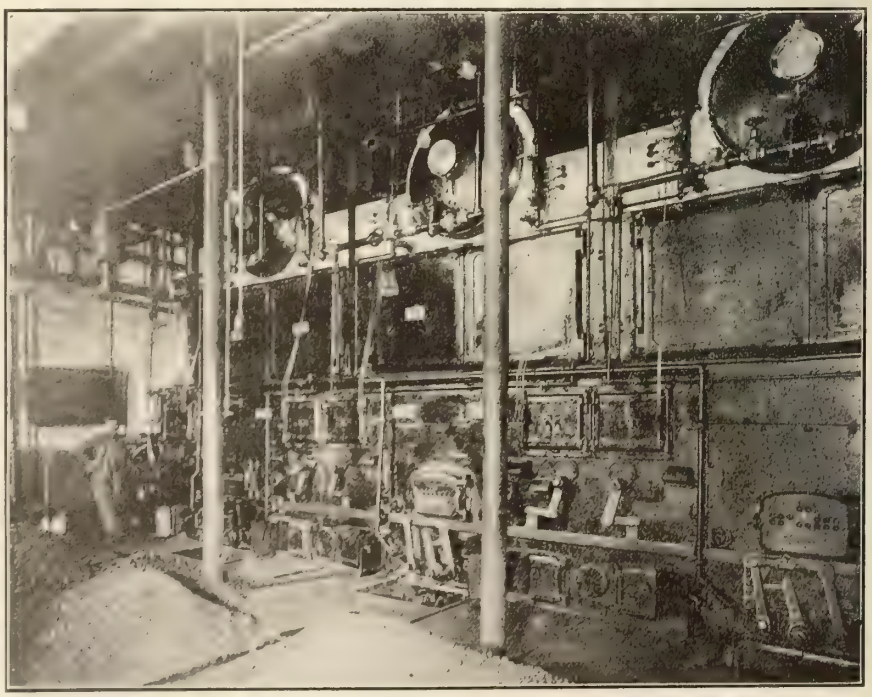


Fig. 2—Harris Abattoir—Boiler room, showing Heine boilers and Murphy furnaces.

run at any desired speed between 10 and 75 r.p.m.; the corresponding output of the compressor being 35 to 150 tons.

Pipes and Fittings.

The steam pipes to all three engines are fitted with Crane's quick-shut butterfly valves operated by wire cords from the adjoining boiler house. By this means, the engines may be promptly shut down in the event of a serious escape of ammonia or other cause.

Condensers.

Each of the three compressors has a separate condenser, so that the engineer is able to judge from the gauges in the engine room and from the temperature of the machines the actual amount of work being done by each unit. With the usual arrangement of one common condenser for all compressors, it is impossible to tell whether each unit is doing its proper share of work.

The 40-ton condenser contains 4,500 feet of 1¼ inch. pipe, all the joints being electrically welded to form a continuous coil. The 65-ton condenser contains 2,400 feet of 2-inch pipe, and the 150-ton condenser 4,800 feet of 2.inch pipe.

The two latter condensers are made up with return bends, having 6-inch centres, to enable repairs to be quickly made in case of leakage.

All three condensers have the latest water spray system, the water being circulated by two centrifugal pumps running at 600 r.p.m. These pumps have a 5-inch suction and 4-inch. discharge, and are belt-driven from a 20 h.p., 3-phase induction motor running at 750 r.p.m. The pumps are cross-connected so that either pump can be used for one or all of the condensers.

The tower in which the condensers are placed is exposed to a good draft of air, which assists in carrying off the heat and keeps down the water consumption. All waste water from the condensers is used in connection with the plant. The condensers are fitted with the latest type of oil separators and rectifiers.

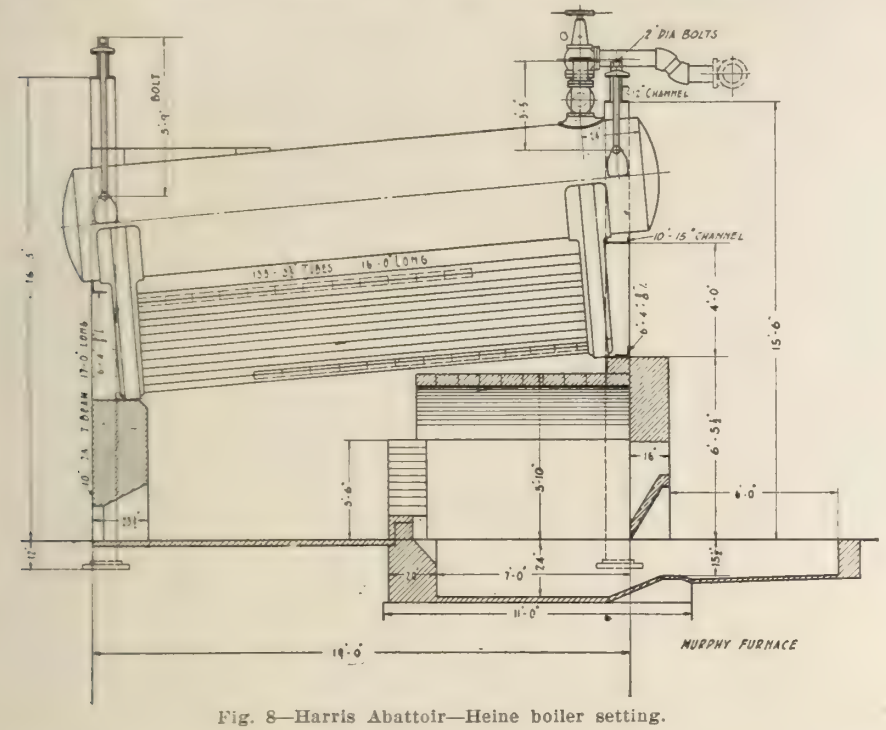


Fig. 8—Harris Abattoir—Heine boiler setting.

Cold Storage Equipment.

The total amount of direct expansion piping in the cold storage rooms amounts to about 52,000 feet of 2-inch pipe. Each and every coil can be operated independently in each room by a separate liquid and suction valve. Other rooms are cooled by cold air; and there is also a brine installation consisting of 600 feet of double pipe, used in the process department.

The plant also includes two air-cooling towers; No. 1 tower contains 4,000 feet of 2-inch pipe, and cools a total room capacity of 150,000 cubic feet, maintaining a temperature of 36 degrees. The air is changed, cooled and washed, once in every 7 minutes. This work is performed by an 80-inch fan, driven by a 10 h.p. 3-phase induction motor running on a circuit of 550 volts at a speed of 150 r.p.m.

Cooling tower No. 2 contains 3,500 feet of 1¼ inch pipe welded into endless coils. It cools a total room capacity of 105,000 cubic feet, and maintains a temperature of 38 degrees. The air in the rooms is circulated by a fan similar to the one mentioned above, and is changed and washed once every 15 minutes. On each tower the water is circulated by a centrifugal pump, having 4-inch suction and 3-inch. discharge pipes. These pumps are driven by a 10 h.p. 3-phase induction motor.

In addition to the aforementioned cooling towers there is a special dry-pipe air cooling tower, consisting of 500 feet of 2-inch pipe. This keeps an egg cold storage room at an even temperature of 32 degrees. The capacity of this room is 54,000 cubic feet, and the air is changed and cooled once in every three minutes.

General Equipment.

Besides the motors already mentioned there are 15 others in various parts of the plant. These range in size from 1 h.p. up to 100 h.p., and all run on city current.

Reverting to the compressors, it is interesting to note that there are no less than 30,000 lbs. of ammonia in circula-

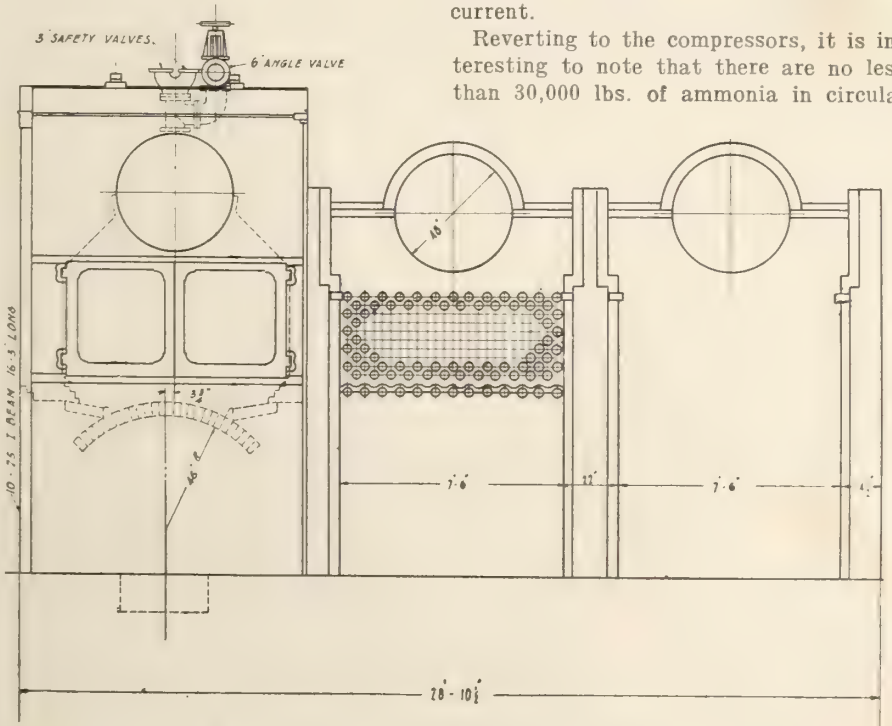


Fig. 9—Harris Abattoir—Heine boiler setting.

tion in the coils and receivers. In addition to this a stock of fifty 100 lb. drums is always kept on hand for replenishing the coils when necessary.

In a convenient position outside the engine room are two ammonia head protectors or helmets for use in case of escape of ammonia. These were made by the Vajens Co., of Richmond, Indiana, and have a capacity of 75 and 100 minutes working time respectively.

Ammonia leaks naturally lead one to think of the compressor stuffing boxes. The chief engineer reports little trouble with leakage of ammonia or suction of air, uses Garlock packing and seldom re-packs his boxes oftener than once in six months.

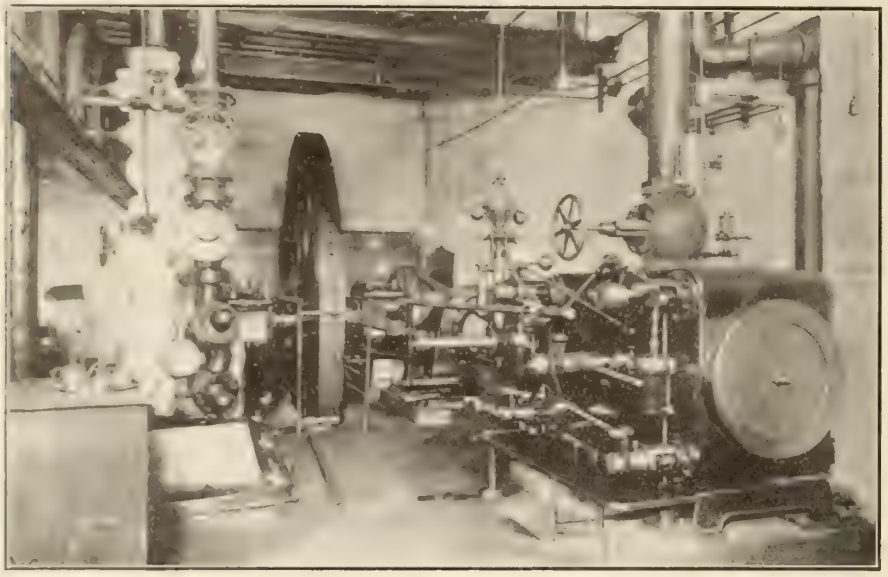


Fig. 5 Harris Abattoir John Inglis Co. engine driving 150-ton ammonia compressor.

Electric Lighting Equipment.

Fig. 6 shows the lighting set switchboard, situated in the main engine room. It consists of one 30 k.w. direct connected unit. A 9x10 Ideal engine by Goldie & McCulloch Co., Galt, drives a Can. Gen. Electric continuous current generator at 305 r.p.m., the voltage being 110.

Provision is made for lighting by city current when necessary. For this purpose there are two Scott connected 40 k.w. transformers converting the city current from 550 volts 3-phase to 110 volts 2-phase.

Power Plant Staff.

The engine room staff consists of one chief engineer and one assistant on each shift, together with one head fireman and two assistants.

Mr. G. Imrie is chief engineer, and Mr. G. Marks is night engineer in charge. Mr. Imrie is seen on the left in Fig. 4. The numerous improvements and additions to this extensive plant have been carried out under the supervision of Mr. W. R. Tyler, the general superintendent, who together with his whole staff take a keen interest in everything pertaining to the reliable, efficient and economical operation of the whole equipment.

Some Problems in the Work of Power Plant Betterment*

By H. H. Hunt**

In this Paper is Undertaken a Brief Discussion of Some of the Problems Which Arise in the Work of Power Plant Betterment, by Which Term is Meant Improvement in Economy of Operation and Maintenance. While the Discussion Will, in the Main, be of General Nature, and Therefore Applicable to Power Plants in General, it is Particularly Applicable to the Steam-Driven Electric Power Plant of the Public Service Company of Moderate Size.

THE general tendency toward consolidation has extended to power plants, and many of the smaller ones have been replaced by large central stations of modern design, operated by high-priced men and with great refinement. There are, however, many of the smaller plants which for good and sufficient reasons are still in operation and which must be operated in the future. In the face of the upward tendency of wages, cost of apparatus and materials, and the downward tendency of rates and increasing demands for improved service, the public service company of today is in a position where the question of economy all along the line, and particularly in that most important part of the property—the power plant, is one of

A casual inspection of one of these small power plants will usually reveal a more or less heterogeneous collection of apparatus and machinery, some of

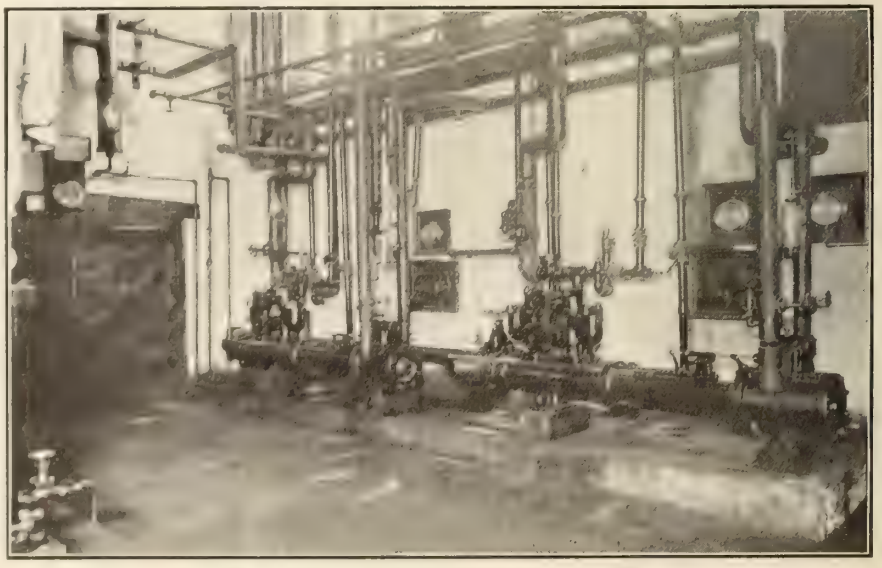


Fig. 3 Harris Abattoir Boiler feed pumps.

which dates back to the early days of the business. In other words, the plant is by no means modern and up to date. This, together with the fact that such a plant is usually operated by a force of engineers and firemen of ordinary intelligence and ability, might naturally lead to the conclusion that even under most favorable conditions, high power costs are to be expected.

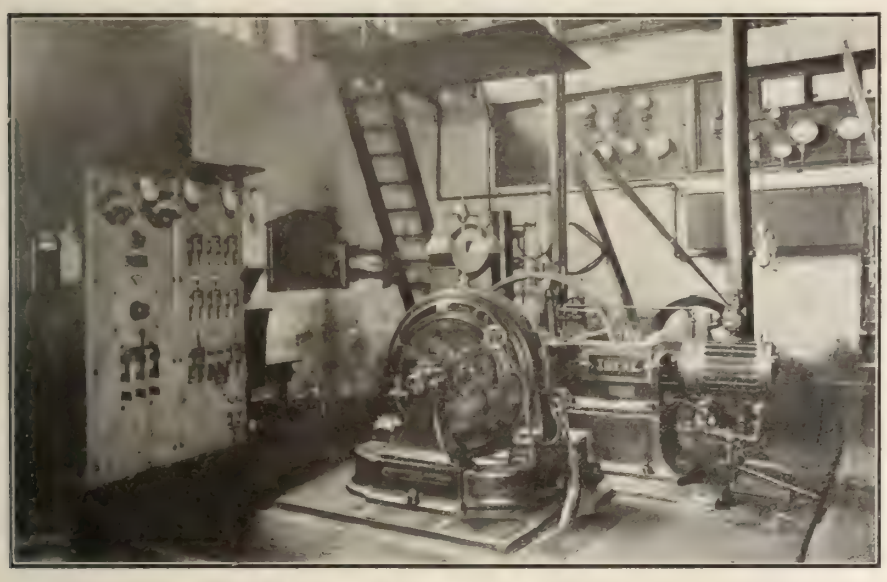


Fig. 6—Harris Abattoir—Lighting set.

On the other hand, a careful and detailed examination by an expert in power station operation will almost invariably reveal features which are capable of marked improvement, and suggest recommendations which, if properly carried into effect, will result in material reductions in costs of manufacture and maintenance, without the expenditure of a large amount of money.

Carrying Out Recommendations.

It has just been said, that improvements will follow if the recommendations are "properly carried into effect." This is a most important point to be borne in mind in any attempt to increase the economy of a power plant. It is a simple matter to employ a competent expert, allow him to make such examination and tests as will enable him to calculate possible savings, and make detailed recommendations and give instructions as to how the possible savings may be secured, but if the betterment work stops here, little will be accomplished, for the simple reason that the man who must carry out the work—the chief engineer of the plant—unless he be an extraordinary man for the position he occupies, will not have sufficient capacity and initiative to enable him to get the desired results.

It will be necessary to retain the expert for a sufficient length of time to enable him, by detailed attention to the actual operation of the plant, under regular working conditions, to not only demonstrate the correctness of his recommendations but also to instruct the power plant organization, to such an extent as will enable them to continue the work after he leaves. As above stated, this is a point of great importance. It has not been sufficiently appreciated in many instances, with the result that much money has been wasted on engineering work, and a feeling of distrust has been created in the minds of the owners in regard to experts, because the desired results did not automatically follow their examination and report. Power plant betterment, like everything else, only if undertaken along proper lines, will produce satisfactory results.

Personal Points to be Noted.

In undertaking the betterment of operating conditions in a power plant, attention should first be given to the personnel of the operating force. Desired results cannot be obtained by incompetent men. It goes without saying that the chief engineer, who must be primarily responsible for what takes place in the plant, should be a man of both operating and executive ability, capable of enforcing strict discipline. He must be capable of receiving instruction, as must also the other members of the force. Each man who does not possess the possibility of becoming a thoroughly efficient and alert member of the force should be replaced as soon as possible. Most careful study will be required in arriving at correct conclusions with reference to each individual of the operating force, in order that justice may be done.

It not infrequently happens that certain men develop unexpected ability as they gradually become familiar with the methods by which actual improvements are brought about. Furthermore, every reasonable opportunity should be given the existing employes to measure up to the new requirements in order to avoid the demoralization to the organization which would be caused by the needless discharge of men. Under the improved conditions the general tone of the power station force should improve in a marked degree, and in place of indifference and lack of ambition should be found alertness, efficiency and a greatly increased interest in the work, all of which are necessary to success.

Physical Examination of the Plant.

A thorough physical examination of the plant should be made and immediate steps taken to correct such defects as can be remedied without excessive cost. Starting in the fire room for instance, boilers will be thoroughly overhauled and cleaned, leaky tubes replaced, blow-off cocks and valves made tight, gauge glasses and dampers put in order, air leaks in boiler settings removed, furnace linings, bridge walls and grate bars put in order, safety valves adjusted and steam gauges calibrated, etc.

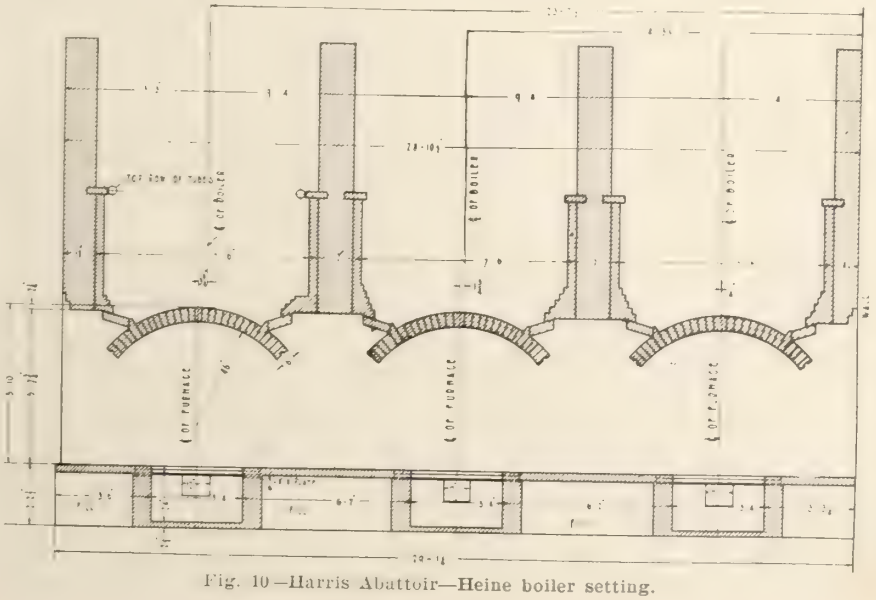


Fig. 10—Harris Abattoir—Heine boiler setting.

The work will continue in like manner to the engines, paying particular attention to valve setting, steam piping, pumps, condensers, heaters, oiling systems, electrical apparatus, wiring and other vitals of the plant. All gauges meters and measuring instruments should be calibrated and tested, so as to give accurate information regarding operation. Attention should be given to matter of tools, and it should be seen that a suitable assortment is provided, both for the engine room and fire room

The station should be thoroughly cleaned and all housekeeping matters given proper attention, for while theoretically there may be no connection between cleanliness and economy, a dirty, ill-kept plant indicates inefficiency.

With the physical plant in good working condition and the power plant crew in an alert and receptive mood, the details of operation may now be taken up.

Details of Operation.

All firemen will be individually instructed in the handling of the particular coal in use; the use of properly designed fire tools, the proper operation of the dampers and proper control of the draft. A thorough course of training along these lines will usually be found necessary, and it will be further necessary to instruct the chief and watch engineers in every detail of the proper handling of the fires in order that they may be able to maintain intelligent oversight of the fire room.

Special attention will be given to the maintenance of boiler pressure and temperature of feed water, in order to avoid the usual fluctuations which so largely affect station economy. Recording pressure gauges, a feed water thermometer and a bulletin board in the fire room, on which are posted the coal consumption and pressure records of each watch, will serve a useful purpose in exciting rivalry among the men. It is in the fire room that money in the shape of fuel, is actually burned. At this point, the fuel which is the source of power, is consumed. It is essential that no detail which will affect fire room economy should be overlooked. An operating engineer can profitably spend a good portion of his time in intelligent personal supervision of the fire room operations.

Presumably the engineers will understand such matters as the starting and stopping of their engines and generators; nevertheless, the attention of the expert should be carefully directed to the engine room.

It is of importance to provide operating schedules so that the varying conditions of load may be met by the economical use of apparatus; in other words, so as to avoid the use of three boilers when two are sufficient, and so on. A most careful study of the load conditions will be made and charts prepared which will show clearly just what combinations of apparatus and machinery should be used to meet the various conditions of load, the idea being to so arrange the schedules that each piece of apparatus, when in use, will be operated as nearly as possible at its point of maximum efficiency.

A careful designed station log will also be provided which will contain the daily operating data of the plant recorded in a systematic manner. In such a station log it is very desirable that the main facts, such as coal consumed per kilowatt hour, water evaporated per pound of coal, etc., be shown so clearly that the manager of the company, by spending a few minutes daily in the study of the station log, may fully acquaint himself with the daily operation of his plant and be in a position to intelligently discuss matters with his chief engineer.

Question of Fuel.

The coal question is one of the most important, and one of the most troublesome, which is encountered in power plant operation. The quality of coal must necessarily depend to a certain extent upon the location of the power plant as related to the sources of coal supply. It will be found profitable to have a careful investigation made of the possible sources from which coal may be secured at reasonable prices. Full data should be gathered regarding the analysis of the various coals available and that coal selected which will meet local conditions with best results. While not always practicable, it is none the less desirable to purchase coal on the analysis basis, under carefully drawn specifications which provide for forfeiture and bonus according to whether the coal falls short of or exceeds the requirements of the contract. Under such a contract an analysis of each shipment of coal is necessary. Where the annual consumption is comparatively small, it is not practicable to purchase coal on the analysis basis, in which event the best that can be done is to buy it of responsible dealers who handle the best coal to be had under the circumstances.

Fuel Accounting.

The accounting for coal purchased, while seemingly simple, proves in practice more or less troublesome. Coal is frequently purchased and paid for according to bill of lading weights. The consumer is liable to suffer shortage under this method of purchase and to start out with substantially less coal in his coal pile than is called for by his books. It is obvious that ultimately the cost of the coal consumed must check with the cost of coal purchased, and in order to bring about this agreement, frequent checks between station records, coal on hand and fuel accounts are necessary. It will be found desirable to arrange proper scales for weighing in bulk the coal which comes into the yard, and if a contract for purchase can be so arranged as to make payments on basis of company's weights, one question of coal shortage will be removed. Bins should be provided which will enable the coal supply to be accurately measured at any time. The coal passing into the fire room must be carefully weighed and weights recorded. With this data at hand and this system carefully followed, there is no excuse for coal shortage.

Power Plant Maintenance.

Proper and systematic maintenance is an important part of power plant betterment work. It is not infrequently the case that the maintenance of a plant is handled in a haphazard fashion, and that full value is not received for the money expended. It is not sufficient to wait until something breaks before giving it attention, for the breakdown may occur at a time when the machine is needed to maintain continuous service, to say nothing of the excess cost of repairs over what would probably have been the case had the condition been anticipated and the break avoided. Low cost of maintenance does not always indicate thorough or economical maintenance, for while it may be possible to run for months on abnormally low maintenance costs, the time will come when the accumulation of deferred maintenance will produce a condition of affairs which will require excessive expenditures, if not for new apparatus, certainly for the overhaul and repair of the old. It is therefore desirable to prepare a proper maintenance schedule which shall be carefully and conscientiously followed by the operating force. Such a schedule will set forth definite dates for the inspection of all apparatus; the schedule to be arranged so that each and every part will receive periodical attention as often as is necessary to keep it in good operating condition.

The history of such systematic maintenance is of value to those in charge, as it enables them to pursue the work with greater intelligence and expedition. A log book should therefore be used in connection with the maintenance schedules, and in this log book should be carefully recorded in detail, the results of all inspections, repairs, adjustments, etc. By the aid of this log and a careful adherence to the schedule, proper maintenance of every part of the plant will be assured and unexpected breakdowns practically avoided. In the ordinary plant, with its usual lack of reserve apparatus, continuous service which is so necessary to success, cannot be expected if proper and systematic maintenance is neglected.

Betterment Work Returns.

What may be expected as the result of this power plant betterment work? First, accurate knowledge of the maximum efficiency of which the particular plant under consideration is capable; second, the securing of this efficiency through the efforts of a well trained efficient operating force; third, systematic and economical maintenance producing maximum life of apparatus and continuity of service; fourth, in case of failure to continue to produce results, a knowledge of the reason why.

Experience has shown that the saving in power costs, resulting from power station betterment work, will cover the cost of the necessary expert services in connection with the same in a comparatively short time, depending, of course, on the amount of saving effected. The continued operation of a power plant under the conditions established by successful betterment work, calls for most active and energetic work on the part of the operating force. In fact, from the manager of the company all along the line down to the coal passers in the power plant, every man must work under high pressure. After the novelty of the improved condition wears off, the operation of the plant becomes not only monotonous but exceedingly strenuous. It is so much easier to slip back a little than to maintain the required pace, that frequent checking of the plant operation is necessary. The manager must give his personal attention to this matter, and he will doubtless be surprised to note the effect of his failure to carefully follow up the matter of daily checking of the plant, if for any reason it becomes necessary for him to temporarily discontinue his critical study of the daily station log. It will require his constant study, criticism and encouragement to keep the operating force in the power plant keyed up to the work required of them.

Periodical Investigation.

In spite of all reasonable efforts, it is quite likely that the economy of the plant may gradually decrease because of a combination of little things which creep into the operation of the plant unnoticed by the engineers. This has been noted in actual experience and has led to the belief that a periodical power plant audit by a competent expert is necessary just as it is found necessary to periodically audit the accounting department. Such an audit will require less time than for the original examination, especially if both examinations and audit are made by the same man.

It should not be inferred from what has just been said regarding the daily check and periodical audit that the economical operation of a power plant is impractical because of the detailed attention required on the part of the management and operating force. Not only has experience proved the contrary to be true, but results have clearly justified the trouble and expense. Power plant betterment work has come to stay.

FIRST COST AND ANNUAL OPERATING COST OF FIVE SMALL PRODUCER GAS POWER PLANTS.*

The following are actual records of operation of small producer gas power plants:

Plant No. 1:
35 h.p. anthracite producer,
28 h.p. two cylinder engine,
18 kw. electric generator (belted),

Cost installed	$ 3,000
Interest and depreciation at 10 per cent	300
Supplies and repairs	150
Labor per year	500
Total	$ 950
Fuel charge per kilowat with coal at $430	ct.
Operating charges per kilowatt	.61 ct.
Total cost per kilowatt hour	.91 ct.

Plant No. 2 (24 hour a day service):
150 h.p. lignite producer,
150 h.p. gas engine,
100 kw. electric generator (direct current),

Cost installed	$ 960
Interest and depreciation	960
Supplies and repairs	480
Labor per year	1,700
	$ 3.140
Cost of fuel per kilowatt hour	.17 ct.
Cost of operation per kilowatt hour	.43 ct.
Total cost per kilowatt hour	.60 ct.

Plant No. 3 (24 hour a day service):
300 h.p. anthracite producer,
Two 150 h.p. gas engines,
Two 100 kw. alternating current generators operating in parallel,

Cost installed	$22.000
Interest and depreciation	$ 2.200
Supplies and repairs	1.100
Labor per year	2.400
	$ 5.700
Cost of fuel per kilowatt hour	.30 ct.
Cost of operation per kilowatt hour	.40 ct.
Total cost per kilowatt hour	.70 ct.

Plant No. 4:
400 h.p. bituminous producer (suction type, 24 hour day),
400 h.p. tandem double-acting engine,
200 ton ammonia compressor (direct connected),

Cost installed (without compressor)	$ 4.400
Interest and depreciation	4.400
Supplies and repairs	2.200
Labor (three shifts)	6.353
Fuel at 1¼ lbs. per horsepower	2.916
	$15.869

Total cost, .459 ct. per horsepower hour.
This last plant was operating on Illinois Slack of 10.300 B.T.U. per pound, and containing 4 per cent. sulphur and 38 per cent. volatile matter.

MONCRIEFF GAUGE GLASS.

These glasses, which are made by Moncrieff in Scotland, are the product of 3 special conditions; first, the special skill acquired by over 40 years manufacturing; second, a secret process and mixing of ingredients; third, the climate as an aid in giving the proper temper to the glass.

Like the case of some yarns which can best be manufactured in certain places, on account of the climate, so in the case of the Moncrieff gage glass, the climate of Scotland is helpful in producing the results. Even were Scotch sand with the other ingredients, and skilled Scotch workmen employed in other localities, the makers state that the same results could not be attained there as are secured in the Scotch factory.

Two brands are made, the Unific for high pressure, up to 400 lb. steam pressure, and the Perth brand for pressures up to 200 lb. Each batch of glass is carefully tested, as are the tubes. Examples are quoted by the makers, of glasses which have been on boilers for over a year and are still in use, of those which have been in constant use for 14 months, and not yet broken, and of tubes on a locomotive used 98 days, and covering 12,129 miles in weather ranging from January to May. The glass is of a peculiar quality, so hard that a diamond makes but little impression on the outside suriace, therefore, water will corrode it very slowly, if at all. The mixture is also one which gives a tough glass, not readily affected by heat and cold. It therefore remains clear for a long time and withstands even the hardest conditions. W. J. Wall, Bleury Street, Montreal, is Canadian representative.

THE ENGINEER OF TO-DAY.

During the last quarter century an extraordinary change has taken place in the position of the engineer in the community. The advance in scientific knowledge and the broadening of the engineering field has seemingly made necessary an extremely composite type of training for the engineer who would have complete command of the field. The engineer of to-day was thus defined by Prof. Henry P. Talbot of the department of civil engineering at the Massachusetts Institute of Technology in an address at the 50th anniversary of the founding of that institution. The wholly successful engineer of the day (I do not speak now of the recent graduate) must be a man possessing capacity for logical, quick and exact thought; a detailed knowledge of some portion and a broad knowledge of the whole of his professional field; and be a master of a certain amount of technique of his profession. He must have the ability to select and guide competent and trustworthy associates and to obtain from them loyal and willing service. He must be strong in his sympathies and generous in his public services, and while quick to enlist desired interest in his enterprises, he must be shrewd in detecting avarice or perfidy. He should be a loyal husband and father, and should find opportunity for that enjoyment of art and literature which will afford him present pleasure and ensure the happiness of advanced years. It is a matter for sincere rejoicing that the engineering profession has reached such a commanding position in our national life, that only a man of this type can completely fill it; but the imperfect portrait just drawn is evidently that of a man for whom Nature must have done much at the start, and toward whose efficiency many elements must have contributed.

*Extract from a paper by Godfrey M. S. Tait, before the National Association of Cotton Manufacturers, April 12-13, 1911.

Theoretical Advantages Due to Superheated Steam*

A Review of the Improvements That Have Been Made in Superheated Steam Practice, to Utilize it to Better Advantage in the Economical Production of Power.

By H. G. Bertram, B. Sc.

THE saving due to the use of superheated steam in engines might well be studied under two divisions—the theoretical saving and the practical saving—and we have here one of the rare instances where the saving in practice is greater than the saving calculated.

Theoretical Advantages.

The thermal efficiency of an engine depends entirely upon the range of temperature through which it works, and this efficiency is expressed by the equation:

$$e = \frac{T_1 - T_2}{T_1}$$

where e=efficiency,

T_1=temperature (abs) of the steam on entering,

T_2=temperature (abs) of the exhaust steam.

Anything, therefore, that will increase the temperature range will increase the efficiency. The lower temperature can be kept down by using a condenser with a good vacuum and the higher temperature can be increased in two ways, by increasing the pressure and by the use of superheated steam. To the former method there are many objections, the strongest probably being the great additional strength required in the boiler and piping to stand the high pressure, and the small rise in temperature obtained per pound rise in pressure. Reference to the steam tables will show that at 125 lbs. pressure the temperature is approximately 352.5 deg. Fah., and at 200 lbs. pressure the temperature is 387.5 deg. F., representing a rise in temperature of only 35 deg. F., with a rise in pressure of 75 lbs.

By using the latter method we have combined the advantages of a high temperature with a low boiler pressure. The steam formed at 125 lbs. pressure can be quite easily superheated from 100 deg. to 200 deg. F., giving a total temperature up to 550 deg. F., while to get that temperature by increasing the pressure the gauge reading would have to be 535 lbs.—an impossibility in ordinary boiler practice.

Difference in Efficiency.

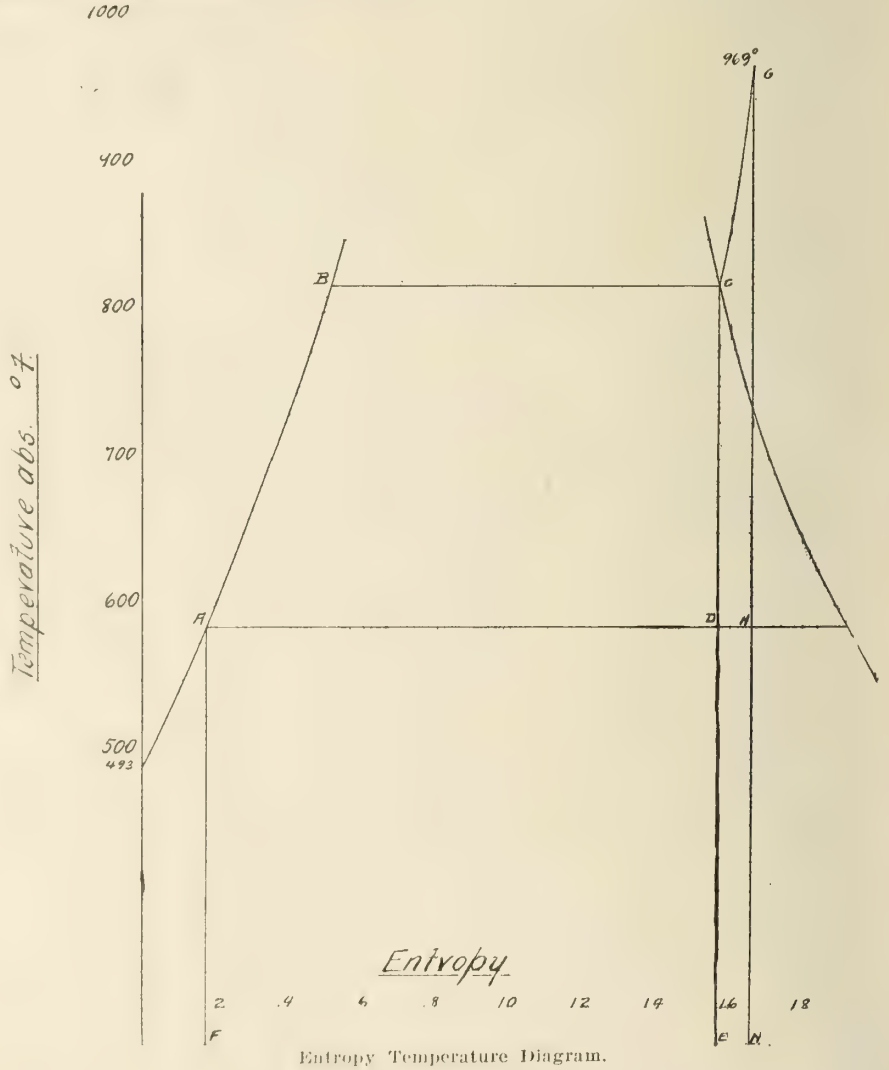
To make this difference in efficiency clear, two problems will be worked, one using saturated steam and the other using superheated steam—both being between the same pressure ranges. The calculations will also be carried on with reference to the entropy-temperature diagram, which will assist materially in representing graphically the heat cycle.

Problem I.

What is the efficiency of an engine taking steam at 150 lbs. per sq. inch absolute, and exhausting into a vacuum of 25.5 inches of mercury—barometer reading 29.5, and assuming that dry steam is supplied to the engine?

From this the absolute pressure 29.5 —25.5 —4 inches of mercury. Heat supplied to water in heating it to the temperature corresponding to the boiler pressure is equal to the heat added along line H B=358.2—125.6=233.6 B.t.u. Heat supplied to form steam or the latent heat=heat supplied along B.C.= from steam tables 860 B.t.u., therefore total heat added 233.6 + 860.0 = 1093.6 B.t.u., and this is represented by the area ABCDEF in the figure.

From the point C the steam expands adiabatically and does work until the point D is reached. From D it condenses along the line D A, therefore the heat converted into work is represented by the area ABCD, and the heat rejected by the area ADEF. The heat rejected is equal to entropy of AD× temperature (abs) at A. The entropy AD is equal to the total entropy of steam at 150 lbs. abs, minus the entropy of the water at point A, therefore the heat rejected =(1.5638—.1741) 586.4 =1.3897×586.4=814 B.t.u.



Entropy Temperature Diagram.

Heat converted into work is the difference between the heat supplied and the heat rejected=1093.6—814=279.6 B.t.u. The thermal efficiency is equal to the heat converted into work divided by the heat supplied= $\frac{279.6}{1093.6}$ = 25.6%

*The third paper will deal with the practical advantages.

Problem II.

Let the steam of problem 1 be superheated 150 degrees Fah., the other conditions remaining the same, and take specific heat of superheated steam .55.

Heat added during superheating= $C_p (T_1 - T_2)$
$= .55 (969 - 819) = .55 \times 150$
$= 82.5$ B.t.u.

Total heat added=heat added in Problem 1+heat added to superheat 150 degrees=1093.6+82.5=1176.1 B.t.u. represented by the area FABCGHN. In this case the steam expands along the line GH and condenses along the line HA.

To find the entropy AH we must know the increase in entropy due to superheat $= C_p \log_e \frac{T_1}{T_2} = .55 \times .1655$ $= .0910$, therefore entropy A.H.=.0910 +1.3897=1.4807.

Total heat rejected = entropy A.H.× abs. temp=1.4807×586.4=868 B.t.u.

Heat converted into work =1176.1—868 =308.1.

$$\text{Efficiency} = \frac{308.1}{1176.1} = 26.2\%$$

Comparing therefore the efficiencies of the engines using saturated and superheated steam we have a gain in favor of the latter

$$= \frac{26.2 - 25.6}{25.6} = 2.34\%$$

The increase in efficiency no doubt appears small and hardly worth striving for, but it must be remembered that the efficiency is much greater in practice for reasons to be explained fully later.

LIQUID FUEL IN ELECTRICITY PRODUCTION.

Wm. H. Booth, F.G.S.

The world's production of petroleum has steadily advanced both in respect of the development of existing fields and the discovery of new fields.

The general public have very ill-defined ideas as to petroleum and its use as a liquid fuel. One often hears expressed the opinion that soon no coal will be used, for it will be displaced by oil. Such an opinion argues a lamentable want of knowledge of the relative production of coal and of oil. In 1902, when I paid particular attention to this, it appeared that the then ratio of calorific capacity of oil to coal was as 1 to 20, and the weight of oil was but 3 per cent. of the weight of coal annually produced. To-day, while the disproportion is not so great, it is still very much of the same order of value. Petroleum must not, therefore, be regarded as offering itself as a universal fuel. Its production is now steadier, and undoubtedly this is tending to put oil forward as a special fuel for special purposes.

In the generation of electricity, expense of fuel is an item seriously to be considered. The generation of electricity, especially for lighting purposes, is a process which involves at times great fuel waste. It is so in seasons liable to sudden fogs. Boilers must be ready to meet the demand that sudden darkness may set up. The light-using public who find their lamps dim, do not realize that they would get four times the light were they to switch off half the lamps they crowd upon the supply, or if they did know most of them would leave to others the duty of acting up to the knowledge.

Boilers in Readiness.

One need not dilate on the waste of keeping many boilers hot and ready for an instant activity, day after day, which may never materialize. The question resolves itself into one of boilers. Electrical engineers have largely adopted the water-tube boiler because they have been of opinion that it was an advantage to have a boiler containing but little water. The very boiler or class of boiler on which they have pinned their faith has been adding to its water contents rather than diminishing this factor.

In choosing boilers, either a fairly considerable water content should be indulged in, or the water content should be nearly nil. That is to say, there should be boilers of both sorts in a lighting station, the larger boilers to carry the steady load at an easy rate of work, capable of doing considerably more work if forced, and the smaller boilers to be employed for sudden demands. Boilers with very little water contents can be started from cold, and steam may be raised to 140 lbs. pressure in five minutes from the time of lighting the fire. With liquid fuel and a small thermal storage vessel, full steam production might be attained by an expectant engineer in ten seconds. A minute would be ample time for ordinary occasions.

Such times as these, of course, demand fully hot feed water, of which a few gallons per boiler alone would be required. The lighting up of every boiler need not require more than the pulling of a lever or two to turn on the spray producing air and the liquid to be sprayed, after an electric ignition coil has been heated to incandescence to ignite the spray. Ignition of the liquid fuel spray may be made by means of a Bunsen flame of gas ignited by electric spark. These should be simple matters for any station engineer to devise. They offer a means for instantaneously lighting up any number of boilers.

Sudden Steam Demand.

It is in this sudden supply of steam to meet sudden demands that liquid fuel should prove valuable. The boilers to be used should be those with very small tubes, say 1 inch diameter; their water circulation should be of the limited order, and their water contents should be a few gallons. The advantage of this type is that very little heat is stored in the boilers, to be lost upon the subsequent and perhaps equally rapid shutting down. This, as regards the fuel consumption, can be instantaneous, and any heat radiated by the hot brickwork can be allowed to continue to generate such steam as it will make.

It is most essential that liquid fuel should be burned in a suitable environment of firebrick, but it is not necessary that such firebrick should be present in great mass. Firebrick linings and baffles should be as light as is consistent with sufficient durability, for in the use of firebrick it is the refractory surface that is required rather than great mass. Firebrick is so bad a conductor of heat that the surface will become brilliantly hot before the interior has become more than warm, and it is undesirable to fill masses of firebrick with heat in order to obtain hot surfaces. Excessive employment of firebrick is responsible for the poor economy of some of the Dutch oven types of furnace, for they absorb heat which is afterwards wasted, making net results poor, especially when working hours are short. For long continued hours of work, great mass in brickwork is of less importance.

The specific heat of firebrick is about a fifth that of water so that the heat absorption can thus readily be calculated. The calorific capacity of liquid fuel is something over 19,000 B.T.U. per pound. Assuming a fire temperature of 3,000 deg. F., the heating of a pound of firebrick to this temperature will call for 600 heat units or, say half an ounce of oil. Thus a large firebrick arch when fully hot may represent from 100 to 200 pounds of oil consumed, showing how important it is to select for load peaks of sudden demand, boilers that are of such a design as to admit of being furnished with light firebrick linings, without heavy arches. It is unfortunate that firebrick is needed, but no hydrogenous fuel can be burned smokelessly, except in furnaces more or less prepared to prevent too rapid absorption of the heat by water-cooled boiler surfaces.

Liquid fuel is particularly offensive when imperfectly burned. Had coal been one half so offensively fuliginous as is petroleum, it would long ago have been supplied with properly refractory furnaces in which to burn perfectly. We hear instead that liquid fuel is so nice and smokeless.—Electrical Times.

Boiler Design, Construction, Operation, Repairing and Inspection *

By H. S. Jeffery

Bracing.

All boilers, especially tubular boilers, are so constructed that a part is self-supporting. The shell is self-supporting because the force acting upon it tends to maintain a circular form. It is also true that the flues of a tubular boiler are subjected to pressure at all points, but

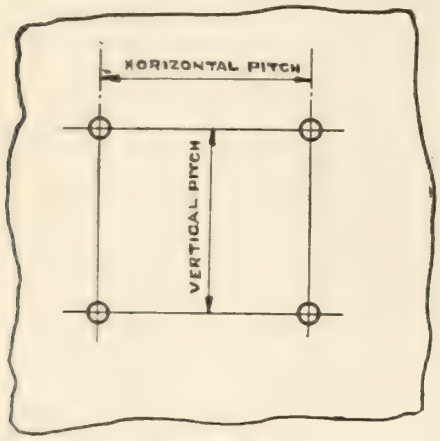


Fig. 34.

the pressure on the shell is internal and that on the flues external, except in the case of water-tube boilers, where the flues are subject to internal pressure.

Parts of the boiler that are not self-supporting must be stayed or braced in a manner which will prevent deformation or bulging when the boiler is in service. There are many ways of bracing boiler parts; the water space of locomotive and similar types of boilers is stayed with staybolts. With staybolts, attention must be given to three things: (1) the area supported. (2) The size of the staybolt. (3) The thickness of the plate supported.

The area is computed by authorities differently. If the staybolts are pitched 4-inch centres, the area would be 16 square inches, and all authorities so figure, but if they are pitched 3¾ x 4 ins., most authorities would figure the area to be supported as 4x4 equals 16 square inches. This rule requires staybolts to be distributed in such manner that the distance between the vertical and horizontal rows will be as nearly uniform as practicable—that is to say, if the staybolts were pitched, say 3½x5 inches, the area supposed to be supported by each staybolt would be equal to 5 squared, or 25 square inches. The area is usually computed by the following formula:

$$\frac{C \times T^2}{D} = P$$

Where:

C=Constant (See note).

T=Thickness of plate in sixteenth of an inch.

P=Working pressure.

D=Greatest pitch of staybolts.

Note: The constant depends upon the thickness of plate and also the authority.

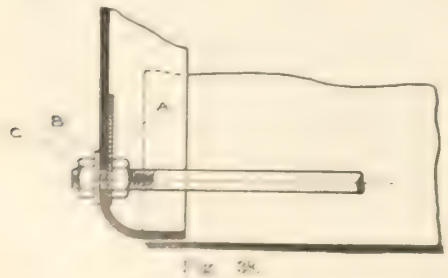


Fig. 38.

In selecting the size of staybolt, one of the first things to consider is the thickness of plate which the staybolt is to support. Now the staybolt may be sufficiently large to support the area allotted to it and the pitch may be about the usual pitch, 4 inches, yet the plate may be so light that the pitch is excessive. This is illustrated by the arrangement, Fig. 34. Assuming the constant to be 110 and pitch 4 inches, the allowable working pressure for a ¼-inch plate would be, $\frac{110 \times 16}{16} = 110$ pounds, and for a ⅜-inch plate, $\frac{110 \times 36}{16} = 247.5$ pounds.

It will be seen by the above that the ⅜-inch plate, while only ⅛-inch heavier, is allowed a much greater working pressure. Further, the size of the staybolt has not been considered—the working pressure has been determined only. The staybolt diameter depends upon the allowable stress per square inch. Since staybolts are subjected to both a direct pull and a vibratory stress, their factor of safety is considerably higher than that of the boiler shell. Again, the threads of the staybolt open avenues for the starting of cracks and as the least area eaten away by corrosion reduces their strength materially, the usual stress allowed is 6,000 pounds per square inch.

With the ¼-inch plate in the foregoing example, the load on the staybolt will be: Area × pressure or 16×110= 1,760 pounds. Dividing by the allowable stress per square inch, the area required will be:

$$\frac{1{,}760}{6{,}000} = .293 \text{ square inch.}$$

The diameter of the staybolt at the root of the thread is then:

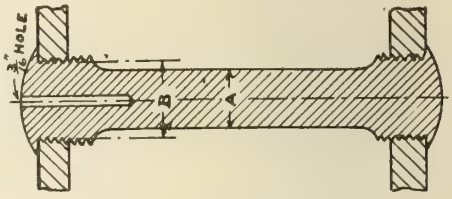


Fig. 35.

$$\sqrt{\frac{.293}{.7854}} = .614, \text{ say } \tfrac{5}{8}\text{-in. diameter.}$$

All staybolts are not threaded their entire length—some are "skinned" out as indicated in Fig. 35. This staybolt has a small 3-16-inch hole in one end, and is a practice used extensively with locomotive boilers, the purpose being to give an alarm by escaping steam when fracture takes place. As staybolts nearly always break at or near the outer wrapper sheet, the tell-tale hole is installed in the end attached to said sheets.

When a staybolt is so "skinned" and the tell-tale hole installed, the area at diameter A, Fig. 35, is ascertained, also the area at diameter B less the area of the tell-tale hole. The lesser of the two is the net area of the staybolt. Usually staybolts are "skinned" out sufficiently that the least area is that from the diameter A.

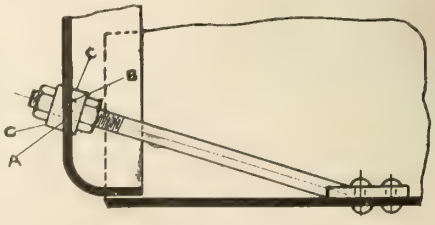


Fig. 39.

It is important to note that staybolts do not always support both sheets to which they are attached. The furnace of an upright boiler is stayed; and the stays are by necessity attached to the shell sheets. Staybolts should be placed at right angles to the surface they support, or as near as practicable. If the staybolt is supporting a curved surface, it should be placed as radiating from the apex of the curved surface. Curved surfaces which are not self-supporting are stayed the same as flat surfaces. The fact that the furnace of an upright boiler would successfully resist 30 pounds steam pressure without staying is not taken into consideration if the boiler is to be constructed and stayed for 100 pounds steam pressure, and the size of the staybolts, their pitch and the thickness of the plate is computed without regard to the curved surface.

When bracing the segment of a boiler, the braces cannot be spaced uniformly. This is illustrated in Fig. 36, where it will be noted that there are three rows of braces and the pitch is 5 by 8¾ inches. Unlike staybolts, the area supported by a brace is computed as the minimum pitch times the maximum by most authorities, and in this instance: 5×8¾ equals 43¾ square inches. Other

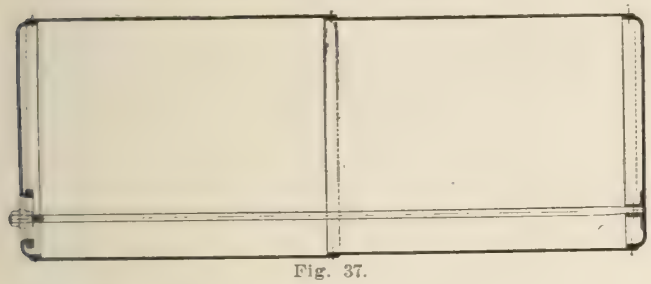


Fig. 37.

authorities used a split-the-difference method as follows:

$$\frac{5^{2}\times 8.75^{2}}{2} = 50.78 \text{ square inches.}$$

The rule used for the rivets is the same as for the staybolts. Example: The distance between the rows of braces, Fig. 36, is 5 inches, while the pitch of the rivets is 4 and 4¾ inches, respectively. This makes three different rivet pitches, 4, 4¾ and 5 inches, respectively. Practically all authorities would figure the area supported by the rivet as: 5×5 equals 25 square inches. It will be seen that to determine the size of brace, necessitates knowing just what method the authority having jurisdiction requires. The rivets which hold the brace to the boiler head are treated as far as calculations are concerned the same as staybolts, the area supported by a rivet being calculated as above.

Direct and Indirect Braces.

Direct braces are to be preferred to indirect, yet it is impossible with some boilers to apply direct braces throughout. Diagonal braces should not be placed at an angle greater than 20 degrees, and with a three-course tubular boiler, it is good practice to have some of the diagonal braces attached to the centre course. The diagonal brace length multiplied by the area of a direct brace required to support the surface, and divided by the length of a line drawn at right angles to the surface supported and to the palm of the diagonal brace, gives the diagonal brace area. Formula:

$$\frac{S\times L}{B} = A.$$

S=Sectional area of direct stay.
L=Length of diagonal in inches.
A=Sectional area of diagonal brace.
B=Length of line drawn at right angles to boiler head or surface supported to palm of brace.

Example: The diameter of the direct brace is 1 inch, length of diagonal stay 60 inches, line drawn at right angles, boiler head to palm of brace 48 inches. What is the sectional area of indirect brace?

$$\frac{.7854\times 60}{48} = .981 \text{ square inch, say } 1\tfrac{1}{8} \text{ in.}$$

In Fig. 36, the manhole below the tubes permits entrance into the boiler for the purpose of inspecting, cleaning, and repairing; and necessitates bracing the heads there. This is accomplished in several ways. The front head with the flanged hole is supported by same, yet many require the ring A to be shrunk on. A method of staying, is to apply angle irons to the rear head and fit 2 end-to-end stays as indicated in Fig. 37. Some stay the flues, attaching a liner to the rear head instead of angle iron, and fitting 2 end-to-end stays as indicated in Fig. 38.

The method, Fig. 37, is superior to that in Fig. 38, for the reason that the liner A, Fig. 38, makes a double thickness of plate at a part of the boiler in contact with hot gases. In Fig. 37, the water is in direct contact with the greater portion of the flue head. Further, the nut C and washer B, Fig. 38, will hardly be indirectly cooled by the water in the boiler and will soon burn off. One difficulty with the angle irons, Fig. 37, is that the space for the eye of the end-to-end stay becomes clogged with mud. The manhole in the front head permits this to be watched, however, so there will be no accumulation to the extent that the boiler head will be over-heated and deformation take place.

A brace used to some extent for the segment above the tubes, but rarely below the tubes, is shown in Fig. 39. It is not a good brace as the hole in the flue head is made larger than the brace by at least ¼-inch and when the brace is installed there are openings above and below as indicated by the letters A and B. The bevelled washer C does not bear fairly against the plate at every point, and although the spaces A and B

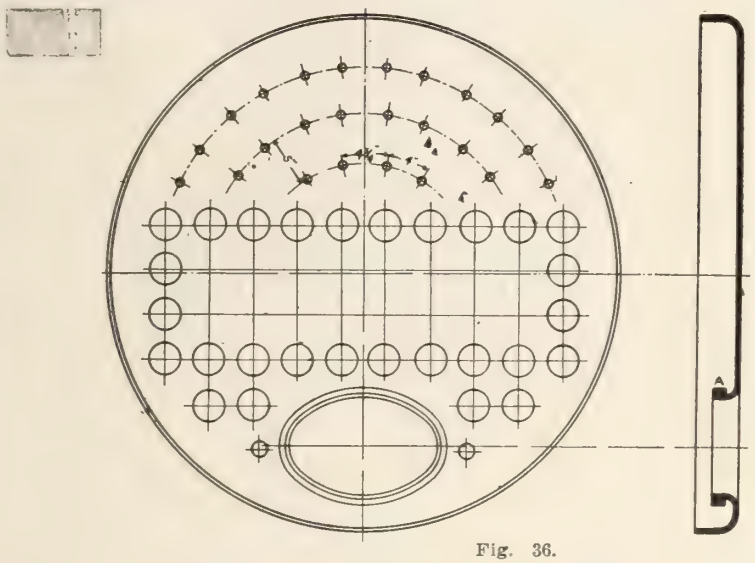


Fig. 36.

are "packed," the packing in time works out and the brace leaks.

WARNINGS.

The Manchester Steam Users' Association issues the following:

Don't overload the safety valves or tamper with them.

Don't let the water level sink out of sight.

Don't allow the cocks and valves to set fast.

Don't open the steam stop valves hurriedly.

Don't empty the boiler while steam is up.

Don't open manholes before easing safety valves.

Don't raise steam hurriedly.

Don't use unknown scale solvent or compositions.

Don't slake ashes against boiler fronts.

Direct Steam Turbine-Driven-Turbo Boiler Feed Pumps

That the Centrifugal or Turbine Pump is Making Headway in the Power Plant for Boiler Feed Purposes, Evidences are Daily Growing More Apparent. In Combination and Direct Connected to a Steam Turbine, There is Formed an Efficient, Compact and Reliable Unit Requiring the Minimum of Attention and Showing a Low Wear and Tear. The Description Herewith Refers to Combination Set Recently Installed at Power Plant in England.

Who first knew who was the first to realize the fact that a suitably-designed centrifugal pump, turbine driven, could be used with success and satisfaction for the feeding of even high-pressure boilers. It is not so many years since centrifugal pumps, as applied to high lifts, were almost unknown quantities; this useful type of water-elevator being applied almost exclusively to the raising of very large quantities of water to a moderate height. In this region its former supremacy is now contested by a later developed rival, but in revenge the centrifugal pump is invading regions hitherto assigned exclusively to the reciprocating form, which attains its maximum of efficiency under such conditions. Where the lift is very high, and the quantity considerable, it seems probable that the best class of reciprocating pump will still hold the field. In other cases however, such as occur in boiler feeding, we have a demand for high lift in combination with a small delivery. The total horse-power involved is in such cases very small at the best, and it has accordingly never been commercially possible to introduce the refinements which have made high-lift reciprocating pumps of the best type so very economical of fuel. The field has therefore been open for the introduction of high-lift turbine-driven centrifugals, which, from the point of view of the power-station engineer, have many excellent features.

The outfit Fig. 1 is intended to deliver 10,000 gallons per hour against a head of 180 lb. to 200 lb. per sq. in. It consists of a Brotherhood turbine designed to run at 3,000 revolutions per minute, coupled direct to a two-chamber Rees Roturbo pump, built by the Rees Roturbo Manufacturing Co., Wolverhampton, England. A good idea of the appearance of the complete plant will be obtained on reference to Figs. 1 and 2, while the constructive details are shown in Figs. 3 to 7.

The turbine, which was constructed by Brotherhood, Limited, Peterborough, England, to their own designs, is a single-stage, velocity compounded impulse-wheel, intended to exhaust at atmospheric pressure. The nozzles are gun-metal castings, bolted to a steam-chest formed in the cover of the turbine, and designed to take steam at 150 lbs. gauge pressure. Two of them can be independently shut off. These nozzles expand the steam down to about atmospheric pressure, and deliver it to a wheel 30½ in. mean diameter, running at 3,000 revolutions per minute. The fixed blading between the two moving rows is fitted, as indicated at A, Fig. 3, so as to be easily removed without dismantling the turbine as a whole; but as the clearance between fixed and moving parts is nowhere less than ⅛ in., the necessity is little likely to arise. The wheel is mounted on a very stiff shaft packed by water-glands where it passes through the casing, and supported externally on ring oiled bearings borne on independent brackets, as shown. This arrangement ensures that heat shall not be conducted from the casing to the bearings, and thus simplifies the question of lubrication. The bearings have phosphor-bronze bushes, and there is a separate strap over each bush; the bearing cover being therefore only a shell, an arrangement which makes it easy to keep the whole oil-tight. An oil-gauge is fitted at the side of each pedestal to indicate the level of oil in the well, and a drain-cock is also provided for drawing off the worn-out oil when a fresh supply is required. The governor is mounted direct on the main shaft, as shown to the right in Fig. 3, and this runs at the full speed of 3,000 revolutions per minute. The thrust is taken by a ball-bearing, and transferred through a hard point to one arm of a system of bell-crank levers and to the spindle of the main-governor valve, which is the one shown next the casing on the left in Fig. 3. The tail of this spindle is ground, and passes steam-tight through a long sleeve, reamed accurately to size, and receives at its outer end the pressure of a spiral adjusting spring. A small hand-wheel screwed on the spindle makes it easy to adjust the speed of the turbine when running, by altering the compression of this spring. An emergency cut-off, shown at B, is also provided. This is normally held open against the pressure of a spring by a catch, but should the turbine speed exceed the safe limit, this catch is knocked out by the expansion of a helical spring joined up to make a complete band, and sprung over the

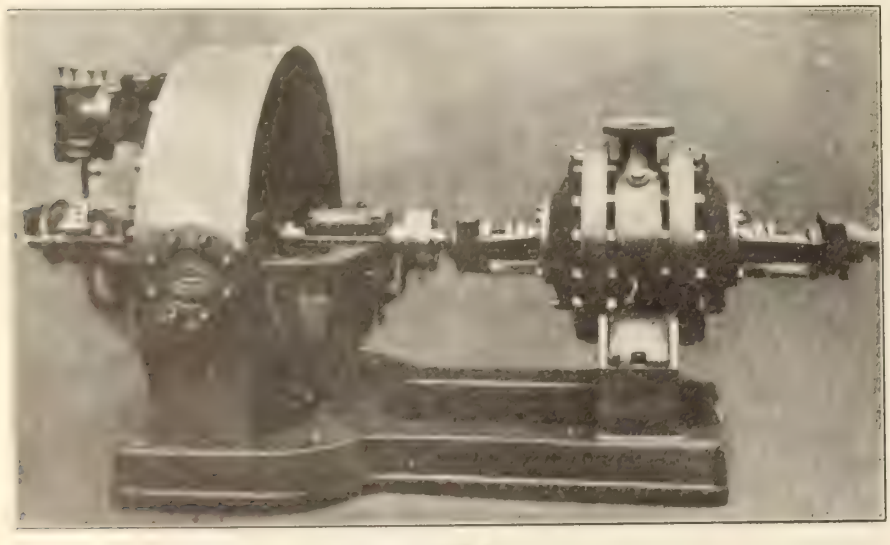


Fig. 1.

Fig. 2.

shaft, as indicated at C. If the turbine races, the centrifugal force causes this spring to expand, and it then comes in contact with a stop, and knocks out the catch, which, as already stated, normally prevents the closing of the emergency valve. An idea of the arrangement of gear at this end of the turbine will be obtained on reference to Fig. 2

and the wheel runs below its critical speed, and is so well balanced that there is an entire absence of noise and vibration

The pump, on the other hand, runs above its critical speed, but is equally vibrationless. It is connected to the turbine-spindle by a "pin" coupling. A longitudinal section through this pump

the passage J, whence it enters the outer eye of the same impeller. From the second ring of diffusion-vanes the water then passes into the inner eye of the right-hand impeller, and the cycle is repeated. It will be noticed that as the water enters the second impeller in the reverse direction to the first, the impellers act the part of a balancing sys-

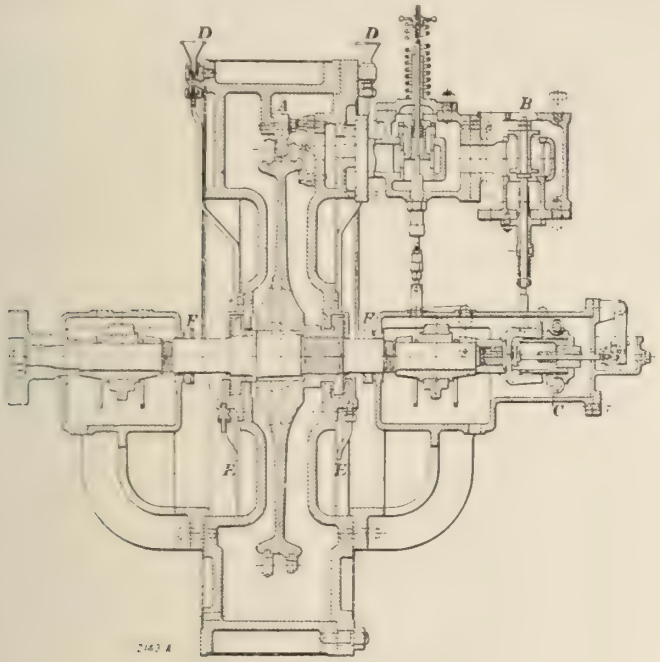


Fig. 3.

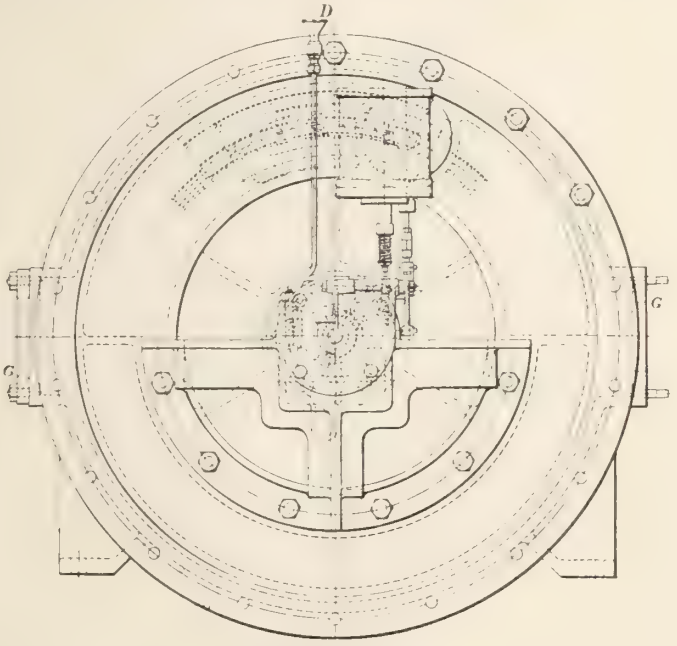


Fig. 4.

The funnels shown at D, Figs. 3 and 4, are for the supply of water gland. The pipes from these funnels enter the gland at the bottom, as shown at EE. Shields, or water-throwers, are provided at F F to prevent any occasional surplus of water creeping from the gland along the shaft into the bearings. Exhaust branches are provided at both sides of the casing, as shown at G, G in Fig. 4, one of which is of course closed by a blank flange, as seen in Fig. 1. The casing is split in halves along a horizontal joint, and the front cover which carries the steam-chest, is also in halves, and like the main casing, is completely lagged. The shaft is stiff

is shown in Fig. 5, whilst the system on which the impeller and deflectors for the diffusion-chamber are designed is clearly shown in Fig. 7, which however, illustrates a single-chambered impeller, instead of the double-chambered one actually used in the feed-pump. The double-chamber impeller is adopted in all the Rees Roturbo series pumps, so as to eliminate end thrust. The suction branch is arranged on one side of the main casing, as indicated by the dotted circle on Fig. 5. The water passes as indicated by the arrow, into the inner eye of the left-hand impeller. On leaving this impeller, it passes through the diffusion-chamber, and is delivered into

tem and do away with the necessity of any external balancing arrangement. The flow of water will be followed more clearly in the diagramatic sketch of the four-chamber twin-impeller pump, shown in Fig. 6.

Referring to Fig. 7 it will be seen that the impeller is essentially a wide box, into which the water enters round the shaft, and in this particular case as already stated, represents a single-chambered impeller on both sides. As it enters the box the water is gradually given a whirling motion by the action of the vanes shown, and as a result an hydraulic pressure is set up near the periphery of the box by the consequent centrifugal action. The water therefore tends to escape through the nozzles HH. These have an area only a small fraction of the area of the waterways inside the impeller, so that, although the water issues from the openings H H with a

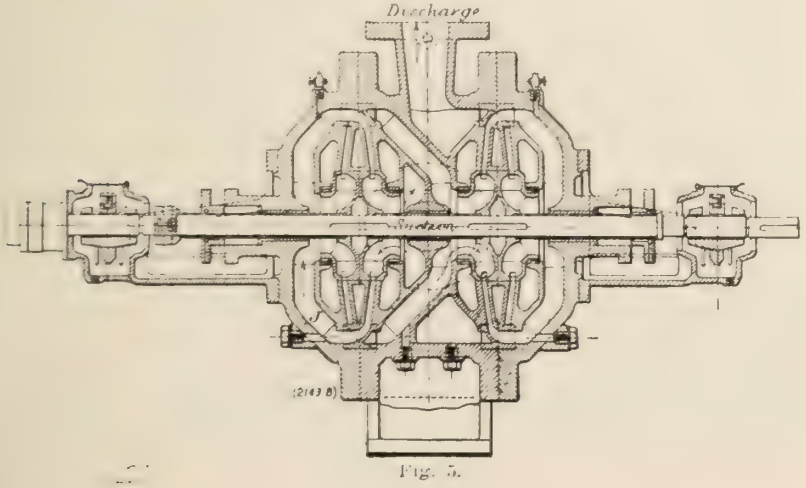


Fig. 5.

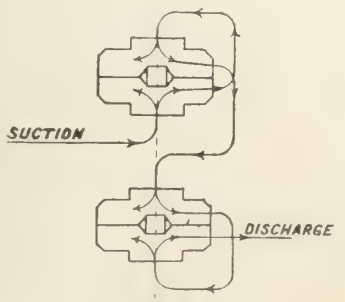


Fig. 6.

velocity of 45 ft. per second or so, its velocity of flow within the body of the impeller is always small, and the frictional loss correspondingly unimportant. The direction of rotation being clockwise, it will be seen that the nozzles are directed backwards. One consequence of this is that if the head be reduced below its designed limit whilst the speed is maintained constant, a larger quantity of water is delivered without any notable reduction in the efficiency of the pump, since the backwardly-directed jets contribute then a larger proportion of the total power needed to drive the impeller. In all cases this power is made up of two elements—viz., the torque applied to drive the shaft, and that arising from the reaction of the jets issuing through H. If the velocity of flow through the latter goes up, this second element increases very rapidly, since not only is the velocity of issue greater, but the weight passed per second is correspondingly augmented. The result is that the pump has a very flat efficiency curve.

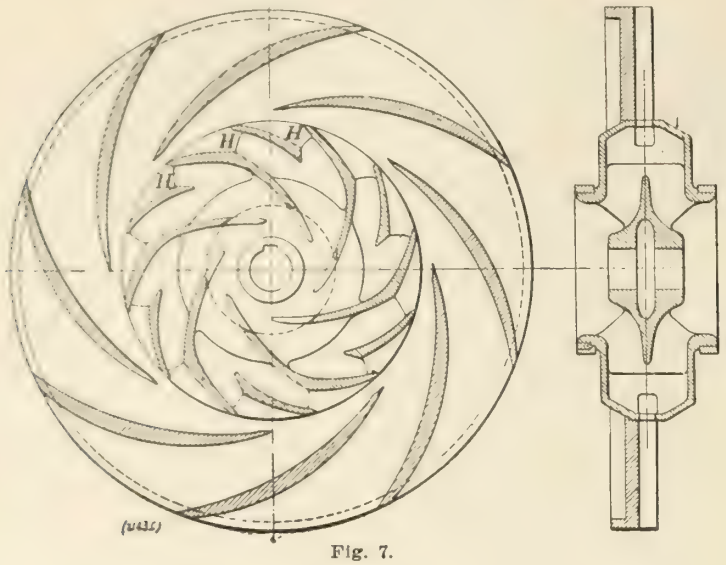


Fig. 7.

On test, using wet steam coming through an unlagged pipe, the pump delivered 195 gallons per minute against 180 lb. pressure. The water horse-power was 24.7. The brake horse-power developed by the turbine was 41.5, and the steam consumption was 33 lb. per brake horse-power per hour, or 55 lb. per water horse-power per hour. These figures compare favorably with those realized by many feed-pumps of the reciprocating type.

It is claimed that the trial efficiency of Roturbo feed-pumps is sustained in actual service. There are, in fact, no parts to wear or to require adjustment which in practice they might not always receive. The maintenance costs are thus low, the oil consumption is also insignificant, and as there is no internal lubrication, the exhaust steam is absolutely clean. The absence of noise also in many cases constitutes a very desirable feature. The attention required is very small, since the pump can be run continuously, the feed being adjusted as required by opening or closing the boiler feed-valves, in which case the pump will automatically adjust itself to the output required.—Engineering.

POINTED PARAGRAPHS.

When anybody tries to sell you a second-hand boiler, ascertain where the boiler had been formerly used and why it was discarded. Do not place much reliance upon the opinion of the party having the boiler to sell. Find out all the facts, and if in doubt—don't take it at any price.

Knowing much about engines, generators, pumps, etc., is commendable, but your equipment as an operating engineer will be lop-sided, and on the wrong side, unless you know more about getting the most out of each pound of coal bought than any other feature of power plant work. What is lost in the boiler room is like time—not to be regained.

Don't jump to conclusions as to the cheapness of any one type of power over another. Steam, water and gas are each in turn the cheapest, if conditions are favorable; but don't forget—"conditions must be favorable." The man who knows the least is the one most apt to opinionate right off the bat.—Ex.

CENTRAL HEATING SYSTEM IN LONDON.

Hamilton & Stott have completed the underground steam heating plant for the Helena Costume Co., London, Ont. This company is a private concern and is now heating twenty-four buildings from the exhaust steam of their plant. One of the largest stores in London, that of Smallman & Ingram, is being heated from this plant and is giving entire satisfaction. This underground plant is the same as the St. Thomas city heating system, the steam pipe being enclosed in a glazed tile and filled with asbestos sponge.

Don't depend too much on automatic appliances, or you will get into the automatic class. No device or appliance constructed by man has ever been able to think. Man must do the thinking in order that automatics may have a fair chance of doing that for which they were designed. Most of them will, provided the man in charge takes proper care of them.—Ex.

3,000 K W. WESTINGHOUSE TURBINE, BRISTOL, ENGLAND.

Engineering says:—We are indebted to Mr. H. Faraday Proctor, for particulars of the remarkably good results in the matter of steam consumption which have been attained on the official trials of a turbo-generator recently supplied by the British Westinghouse Company, Limited, to the Bristol Corporation Electricity Department. The turbine is of the impulse type, velocity compounded in the first stage, there being twelve pressure stages in all. It was designed for a steam pressure of 200 lb. (gauge), a superheat of 200 deg. Fahr., and a back pressure of 2 in. of mercury. Its speed is 1,500 revolutions per minute, and it was designed to take an overload of 25 per cent. The generator, which is separately excited, yields three-phase current at 6,000 to 6,600 volts, with a periodicity of fifty. The results obtained on the trial are tabulated below :—

Approximate load	½	¾	Full	1¼
Output, kw.	1563	2344.5	2930	3645
Speed	1505	1490	1500	1501
Steam pressures	192.5	189.2	195.4	193.6
Steam temperature	556	560	568.1	565
Steam superheat	171.2	176.6	182.1	179.7
Vacuum (30 in. bar.)	28.42	28.47	28.18	27.78
Circulating water inlet deg. F.	41	41	43	41
Circulating water outlet	59	61	64	66
Energy for condensing plant, air and circulating pumps, kw.	45	46	48	46
Steam consumption, total	23,887	33,015	40,200	51,171
Steam consumption, pounds per kilowatt-hour	15.28	14.08	13.72	14.03
Steam consumption, corrected for 200 lb pressure, 200 deg. Fahr. superheat (vacuum as during test)	14.78	13.64	13.47	13.71

Types of Water-Tube Boilers Manufactured in Canada

The Demand for Water tube Boilers is an Outcome of the Varied Requirements of Power Plant Installations, and has Necessitated Steps Being Taken by Many Leading Canadian Engineers and Boilermakers to Equip Themselves with Designs, Plant and Tools to Satisfy the Most Exacting Demands That May be Made on Them, to Supply This Type of Steam Generator. The Brief Description and Illustrations of This First Series of Articles, will, it is Hoped Enlighten and Familiarize Those Engaged in the Many Departments of Boiler House Work, Somewhat More Fully As to What is Being Done and Who is Doing it.

THE ROBB WATER TUBE BOILER.

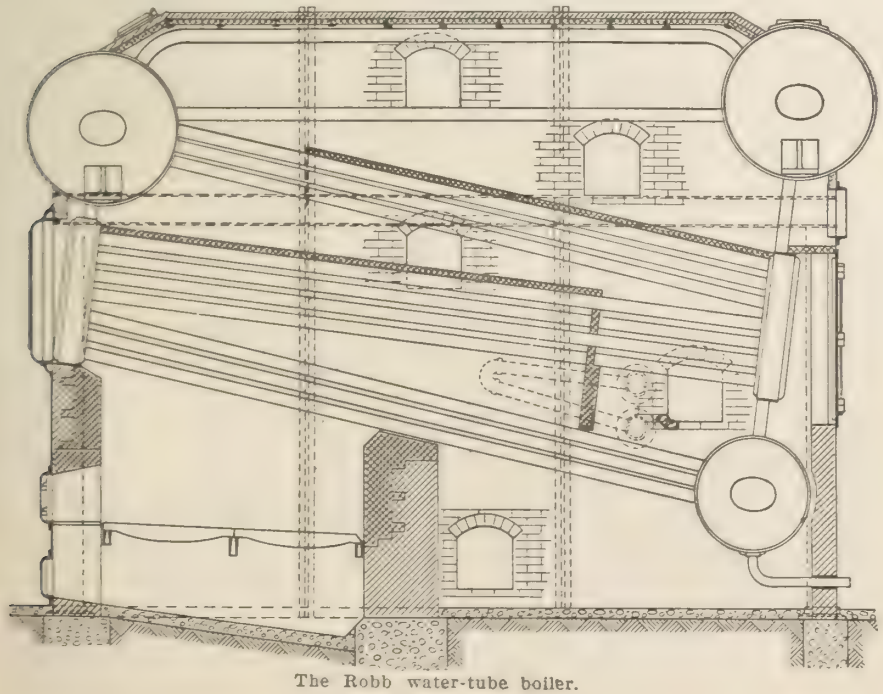
For many years the Robb Engineering Co., Ltd., have been engaged continuously in the manufacture of steam boilers of the Return Tubular, Portable and Marine types. In 1900, the capacity of the Canadian shops, at Amherst, Nova Scotia, was doubled, and after equipping throughout with the most modern hydraulic, pneumatic and electric machinery, they commenced the construction of water tube boilers. In the year 1905 they acquired a boiler business at Cambridge, Mass., and in the following year, moved into new works at South Framingham, Mass., where a specialty was also made of water tube boilers. With two modern plants at their service and an intimate knowledge of requirements gathered during long experience in the construction of high grade boilers, they are building a water tube boiler which meets with the approval of experienced engineers and has been accepted by the most discriminating steam users throughout the United States and Canada.

General Description.

The distinctive feature of the Robb Water Tube Boiler shown in the cut, is two banks of inclined tubes having freedom to expand and contract independently of each other and giving a positive circulation which supplies plenty of water to the hottest places. The entire boiler is carried independent of the brick-work on a steel frame. The front drum is supported by brackets bolted to the framework, the rear upper drum is supported in a similar manner with rolls placed between the brackets and framework, providing for the expansion of the tubes. The inclined banks of tubes, with rear drum and header, are carried by vertical circulating tubes and are free to expand and contract. This construction prevents leaks due to buckling, or working of the tubes, which happens frequently with some designs of water tube boilers in which all the tubes in each vertical row or bank of tubes are connected to rigid headers. The front ends of the lower bank of inclined tubes are about 4 ft. 6 in. above the grate, providing an unusually high and large furnace, insuring perfect combustion.

Circulation.

In the Robb boiler, the lower bank of tubes is connected to a large drum, which provides an ample supply of water for the tubes in contact with the flame and hottest gases. The water circulates forward through the upper and lower banks of inclined tubes into the front drum and header, and back through the horizontal tubes to the rear upper drum. From this point the water passes down through vertical tubes to the rear header, and lower drum. It will be seen that this arrangement gives free and unimpeded circulation in all parts of the boiler, which is essential, both for economy and durability.



The Robb water-tube boiler.

The steam passes from the front drum through superheating tubes which insures the delivery of absolutely dry or slightly superheated steam from the steam outlet at the top of the rear drum. The water is perfectly quiet in the rear drum, as all disturbance due to the upward circulation of water and steam through the lower banks of tubes takes place in the front drum, the circulation from the rear drum being downward.

The feed water enters the rear drum and is free to pass through the upper bank of inclined tubes first, where the temperature is moderate, so that the coldest water is brought in contact with the cooler heating surface, producing an "Economizer" effect in reducing the temperature of the gases before they leave the boiler, and if the feed water contains solvent impurities, the heating of the water gradually in the upper bank of inclined tubes, drums and horizontal tubes, gives the impurities a chance to separate and deposit in the lower drum before reaching the hottest surfaces directly over the fire, where scale would form. Blow-off valves are connected at the bottom of the rear header and lower drum.

The flame baffles are arranged to best advantage so that the gases are forced to travel the full length of the lower bank of inclined tubes, returning the full length of the upper bank of inclined tubes, thence passing along the horizontal and superheating tubes to the smoke outlet at the rear. It is found by experience that this arrangement gives excellent results and prevents all short circuiting and causes the gases to pass over every part of the heating surface. The baffles are constructed of fire-brick tiling which are usually put in place after the boilers are erected, and may be readily replaced or repaired without disturbing the boiler or setting. Ample space is provided between the banks of

inclined tubes for cleaning or replacing tubes and giving good combustion space.

Material and Construction.

The Rums Water Tube Boiler consists of externally fired tubes, steel plate headers and cylindrical drums, all of which are recognized as standard construction for sectional water tube boilers. No rivets or joints are exposed to the fire. The drums are cylindrical, made of one piece of plate for the whole length, the longitudinal seam being a butt joint with inside and outside straps. The water tubes are all straight and only three different lengths of tubes are used in the inclined banks, making it unnecessary to keep a large supply of tubes on hand for repairs. There is a minimum of handholes to keep tight, yet each tube in the three lower banks has a handhole at one end for cleaning or replacing a tube if necessary. The handhole plates have true joints and are placed inside of the header, so that the pressure on the plate tightens the joint and relieves the bolts and guards of unnecessary strain. The handholes are oval in form and so arranged that each plate may be taken out conveniently through its own hole. Manholes of standard size (11 in. x 15 in.) are provided in one end of each drum for inspection and cleaning.

All plates are of the best open-hearth steel. The materials and workmanship comply with the government, state, or marine requirements for boiler construction, and also with the regulations of the boiler inspection and insurance companies.

The boiler horse power rating is based on the "centennial standard" which calls for 34.5 pounds of water evaporated from and at 212 degrees F. Ten square feet of heating surface is provided for each horse power.

THE ERIE CITY WATER-TUBE BOILER.

The John Inglis Co., Toronto, after careful investigation of various types of water tube boilers, and recognising an increasing demand for that class of generator, decided that the Erie City Water-tube Boiler was equal in all respects to other leading makes, and obtained the sole Canadian rights to manufacture.

Design and Construction.

The cut represents very clearly the design and general arrangement of the various details entering into the complete unit. It will be noted that it consists of one or two steam drums, to each end of which are attached water legs of large capacity. The number and size of the steam drums is dependent on the particular horse power capacity requirement.

The water legs receive the tubes at each end, these tubes being arranged in pairs and staggered.

Opposite the end of each pair of tubes there is a hand-hole closed by a pressed steel plate held by bolt and crab. The plate forming the water leg is flanged inward to the water space for a depth of about three-quarters of an inch. This flange, forming the perimeter of the hand-hole, is upon its inner edge faced off by machine to provide a true seat for the gasket packing of the hand-hole plate. The plates being heavy, this faced edge is wide and ample in the surface presented to hold the packing in place. At proper points heavy hollow tubes $1\frac{1}{4}$ inches diameter pass through each leg from outside to outside, affording not only strength, but opportunity to introduce jet blowers for removing dust from the tubes without interruption to the operation of the boiler.

The water legs are of ample size in the distance between the heavy vertical plates of which they are formed. The necks connecting the water legs to the drums are exceptionally large in area, so that circulation is perfectly free and unimpeded to and from the tubes.

The cover of the hand-hole is pressed from heavy plate steel of elliptical form. That portion near the edges, forming the gasket seat, is flat, while the central portion is dished; the dished portion fitting snugly into the hand-hole opening. The shoulder where the pressed-up portion starts from the flat, forms an abutment for the edge of the gasket, backing it up against the pressure and preventing effectually any possibility of being blown out. The hand-hole plate passes readily through the hand-hole. The hand-hole plates and hand-holes are formed by dies in a powerful hydraulic press, and are uniform in size, thus assuring interchangeability. There being but one hand-hole plate at each end for each pair of tubes, the labor of opening up and closing the boiler is one-half of that rendered necessary by a form of

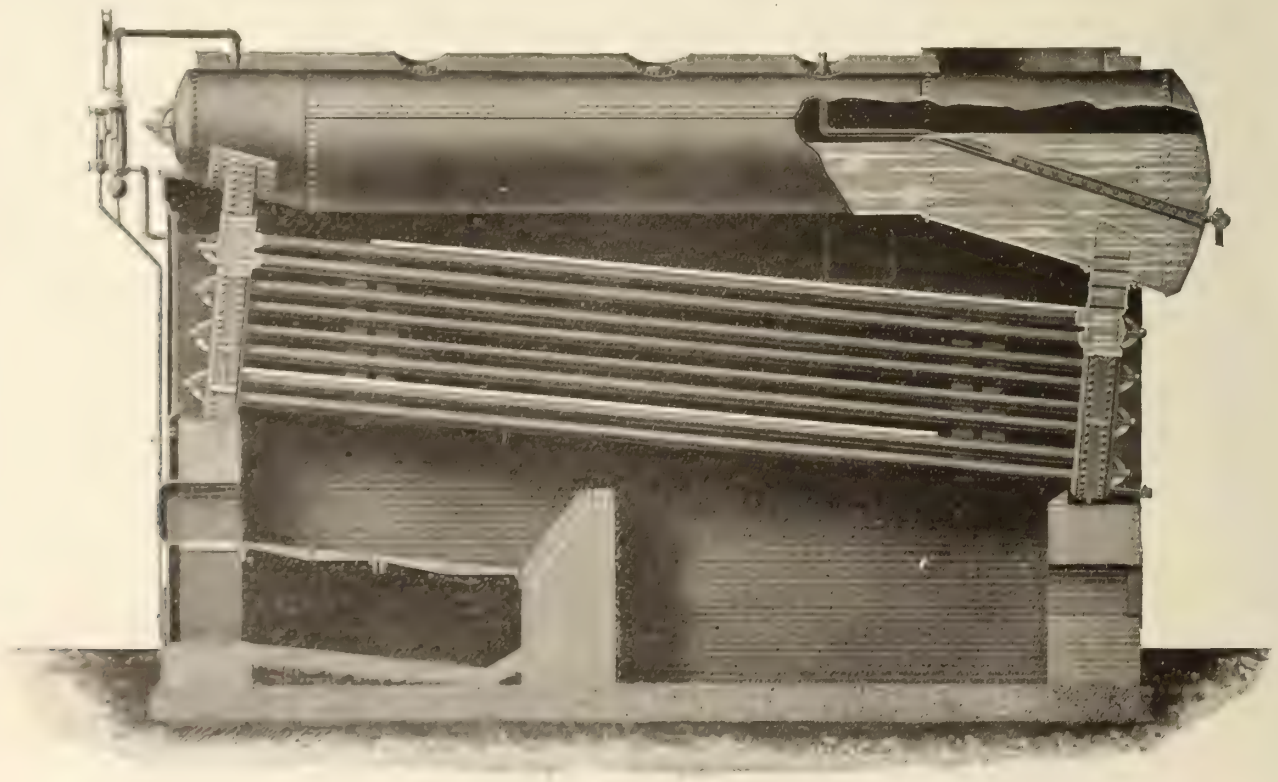


Fig. 3. The Erie City water tube boiler, sectional side elevation.

construction requiring a hand-hole for each tube.

The use of a four-footed crab on the hand-hole ensures its being placed in proper position.

Brackets upon the water legs near their lowest points take the weight of the boiler, rollers being placed under those at rear to compensate for expansion and contraction.

The proportions of plates, rivets and tubes in these boilers are such as fit them for use at high pressures. Cast iron, malleable iron or castings of steel form no part of the boiler exposed to tensile strain, or to the presence of steam. All parts of the boiler exposed to steam or water pressure are of wrought steel or wrought iron. The boiler material is of open hearth homogeneous steel, having a tensile strength of from 55,000 to 62,000 pounds per square inch of section. All parts resisting the pressure of steam or water, except the tubes, are made of these plates.

Combustion Arrangements.

It will be seen by reference to Fig., that the grate bars are at ample distance from the tubes; sufficient to permit combustion to perfect itself before the products pass between the tubes. The tubes are not so far removed from the fire as to lose the benefits of the heat radiated during incandescence. Combustion is further facilitated by the passage of the gases over a bridge wall to the rear, in the manner employed in tubular boiler settings. The gases are forced to take this path by a partition of fire brick laid upon the top tube of each bottom pair, beginning at the front end over the fire and continuous until near the back water leg. From this point, the gases pass up between the middle tiers of tubes into a similar flue, but with reverse effect, carrying them again to the front end of the boiler, where they ascend to the flue space formed between the upper tubes and the steam drum afterwards passing to the exit at rear. In this passage the gases come in through contact with the tubes for their entire length. The reversal of the direction of motion of the gases causes such a mixture of them, that stratification is avoided. Another point in construction worthy of note, is that no time in their course do the gases descend. While the small matter of a few feet cannot make much difference, yet to such construction may be attributed much of the loss of draft observed between the chimney and the furnace. It is usual to find a marked difference between the draft at the base of the smoke stack and that measured at the fire door, amounting in many cases to one-half. By avoiding the more active causes of loss, such as the above, maximum draft effect is secured, and thereby more perfect control of combustion.

Feed Water Arrangements.

It will be noted that a pan forming an inclined partition is fixed in the rear end of the steam drum, extending from the water level to the rear head of the drum downward and backward from side to side. The water, circulating toward the rear water leg, passes under this pan. The feed water is led into the forward end of the pan and is thoroughly mixed with its contents, partaking of its heat before flowing forward and meeting the current flowing to the rear water leg. Owing to the fact that the feed is here fully heated, it deposits at this point and within the pan, the greater part of those solids which become insoluble at high temperatures, and which form the great percentage of scale-producing elements. From this pan the blow-off is led, therefore no mud-drum is required.

This pan being a watertight receptacle, the opening of the blow-off cannot empty the boiler. By opening the valve, all water above the level of the edge of the pan and the contents of the pan itself may be completely blown out. The same operation may be performed by temporarily stopping the feed and permitting the water level to fall below the edge of the pan. This separates the contents of the pan from the remainder of the contents of the boiler. The water can be blown out of the pan, carrying with it the deposited sediment, the blow-off valve closed, and the feed turned on without any perceptible effect upon the use of the boiler for its regular purposes other than the removal of the trapped sediment and mud. The usual means of emptying the boiler from the bottom are also provided. The pan is accessible through the drum man-holes for cleaning out.

Free circulation has been carefully provided for throughout, a point of first importance as regards safety. The water in the tubes circulates freely toward the front water leg, whence it passes without constriction into the steam drum and back to the rear water leg, descending to again enter the tubes and to further absorb the heat of the fire. The drum being horizontal, the water passes easily from front to rear in best condition to liberate the stored heat in the form of steam. The surface in the drums from which this liberation can take place is ample enough to permit this being accomplished quietly, even when the boiler is forced beyond its rating. Dry steam is disengaged with no entrained water. The large disengaging surface in the horizontal drums insures a minimum of moisture and a certain degree of superheat without the introduction of special appliances.

The steam room capacity is ample, and use of the drum in a horizontal position, gives greater volume and a quieter circulation of the contents, than if it were inclined.

The boiler is accessible inside and out for inspection and cleaning, for besides facilities for keeping the inside of the tubes clean, means are provided for removing ashes or dust that may lodge upon the tubes or fire brick. Side cleaning doors permit the introduction of steam jets while in operation, by means of which the dust is driven to proper points for removal.

The boilers are made in standard units for high pressure purposes from 100 up to 500 horse power, are made to conform to the strictest test requirements, and are shipped complete, ready for placing in position and bricking up, thereby avoiding multiplicity of joints and assembling of innumerable parts in the field.

THE GOLDIE & McCULLOCH WATER TUBE BOILER.

The Goldie & McCulloch Co., Galt, Ont., have recently placed on the market a water-tube boiler of their own design and manufacture, recognizing thereby like other leading Canadian boilermakers that such is a necessary adjunct to the building of the well-known return tubular shell type.

As evidence of their successful entry into the water-tube boiler field, orders for 3-500 horse-power units have already been received for installation at Strathcona, Alta.

Conetructional Tetails.

Wrought steel is used throughout, of tensile strength from 60,000 to 65,000 pounds per square inch. The drums are made in diameters of 42 and 48 inches, three rings in their total length, and each ring in one plate. Boilers up to 350 horse power have one drum, while those above that amount have two drums. The former are shipped complete on cars, and the latter require part assembly in the field.

The front and rear water legs connected to the drums, are parallel to each other and inclined to the vertical. The tubes are 4 inches diameter in all cases, and vary from 16 to 18 and 20 feet in length.

The water legs are connected by the tubes which are expanded into the tube plates of same. Opposite each end of each tube is a handhole to permit cleaning, each handhole being of sufficient size to allow any one tube being removed without disturbing the other parts of the boiler. The handhole and tube sheets of the headers are each formed of one plate, flanged to shape in a hydraulic flanging press. These water legs are exceptionally deep, allowing large cross sectional area in the uptake, and admitting of easy water circulation into and out of the drums. When the boiler is set in place the tubes are inclined, the drums being horizontal.

The baffle plates are so placed that the flame crosses the tubes three times, an arrangement giving the best possible means of transmitting the heat to the water. The stay bolts in the water legs are hollow, with holes of sufficient size to insert a blower, for removing soot from the tubes.

The side walls are provided with plates, permitting the insertion of a soot blower between each row of tubes in all three passes. A sufficient number of cleaning doors allows easy access to all parts of the boiler. The steam drums are large and being horizontal, the steam nozzle is connected to the middle ring, from which point the driest steam is obtainable.

The feed water is introduced through the front head through an internal pipe of large area, which allows it to travel slowly to the rear end just above the water leg; the water thereby becoming heated to practically the same temperature as the steam before mingling with the existing water in the boiler. The weight of the boiler is supported at the front and rear ends by steel frames entirely independent of the brick walls, thus preventing any liability on the part of the walls to crack or yield.

Special Features.

A few of the special features claimed for this boiler, are good circulation and complete combustion of fuel; absence of heavy internal scale, straight tubes with easy removal and renewal of same; absence of screwed joints, ease of erection, large steam release area, and steam space, large and small units, with simple design for cleaning and examination.

The heads of the steam drums are dished to a radius equal to the drum diameter, and have a full size manhole with edges flanged inwards, on one end. The tubes are staggered in relation to each other. A full flush front built up in sections and bolted together, constitutes with the usual steam boiler accessories, the finished installation equipment.

COAL PURCHASE ON SPECIFICATION.

Dwight T. Randall in a paper read before the American Society of Mechanical Engineers on the subject of "Coal Purchase by Specification," says that the advantages of knowing accurately the quality of coal which is being burned in a power plant and whether any changes in the coal consumption are due to the coal or to the method of operating the plant, have led a number of managers to make analyses of all the coal delivered. After following the deliveries in this way for a year or more, these men have as a rule decided to place their contracts with the understanding, that if the coal delivered can be prepared so as to eliminate more of the impurities, they will pay a higher price, and if the coal is below quality they will deduct from the regular price accordingly.

Sample Requirements.

On considering the purchase of coal on a guaranteed analysis, the question as to how the sample shall be taken and by whom it shall be analyzed, is raised. The method of taking a sample of coal is fully as important as the manner in which it shall be analyzed, and the cause of doubt as to the value of coal analyses has been largely due to ignorance or carelessness in taking samples. It is only fair to both parties concerned that the sample should be taken in such manner as will secure a small portion which is thoroughly representative of the entire lot. A method quite generally adopted, has shown that when two samples are taken in accordance with these approved methods, results are within reasonable limits of accuracy.

After it has been decided what coal may be burned successfully in any given plant, it is important that the specifications be so drawn that it will be to the interest of the dealer to deliver the kind of coal which has been established as standard in his proposal and prevent the substitution of lower grades which might be difficult to burn with good re-

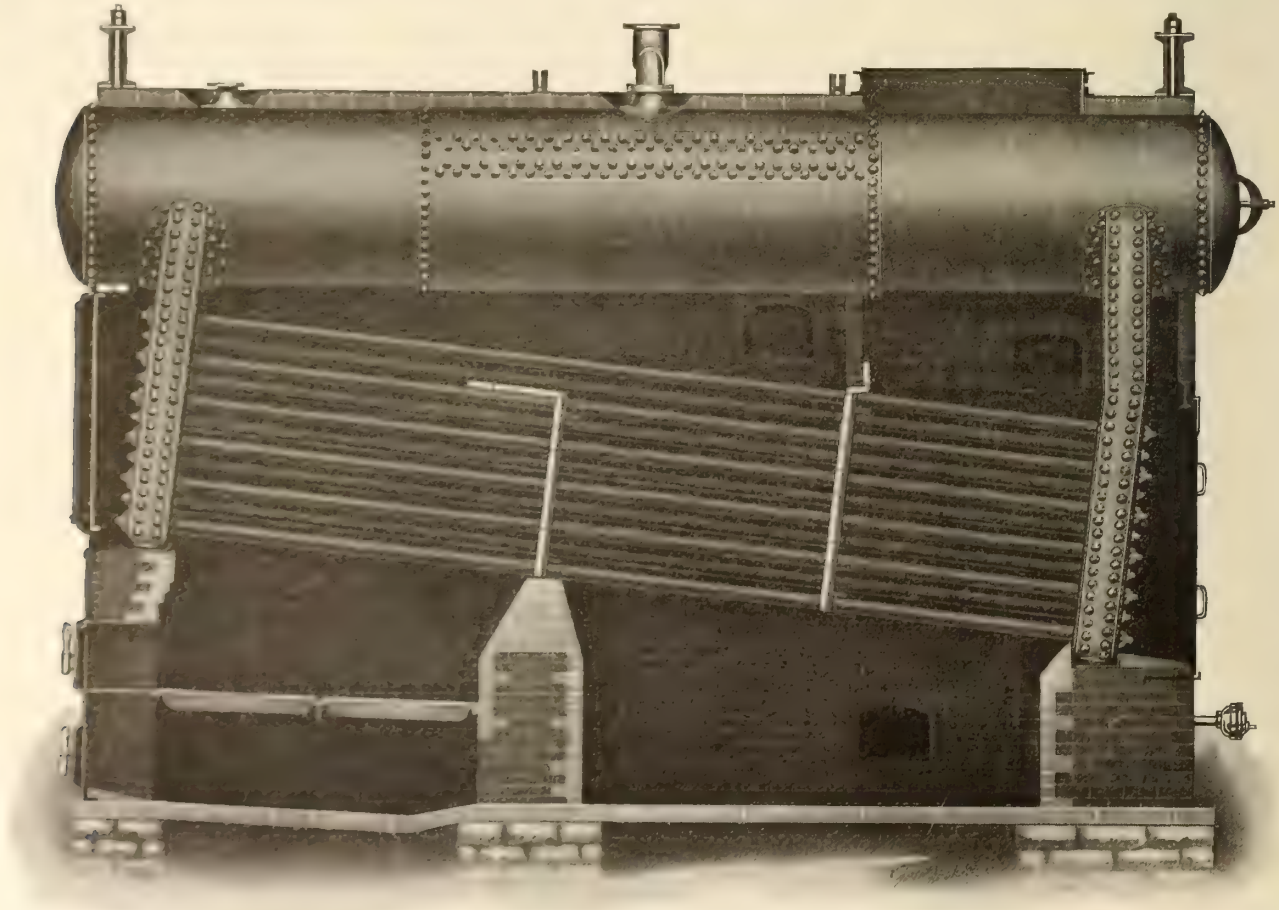


Fig. 1—Longitudinal sectional elevation, Goldie & McCulloch water-tube boiler.

sults. It is evident that a specification based on heating value alone will not do this, and that there should be some clause making it possible to reject the coal or burn it, paying for it at a reduction in price, greater than that due to B.T.U. only.

Protection to Buyer and Seller.

There has been a great deal said for and against the plan of purchasing coal on a guaranteed analysis, and, as is often the case, both sides are right, but they are really discussing different things. A properly drawn specification protects the dealer who is prepared to furnish good coal in competition with dealers handling inferior coals at the same price. Where these specifications permit the coal contractor to state the analysis of his coal which, on acceptance of the bid becomes the standard for the contract, there need be but little variation in the price if the dealer is familiar with the analysis of the coal offered, and if the standard is based on average values, the premiums and penalties for the year should practically balance each other. Many dealers have bid on impossible analysis and then blamed the specification plan for their losses.

The plan of purchasing coal on a specification based on a guaranteed analysis may or may not be a good one, depending on circumstances. It has proved satisfactory in nearly every case when the specifications were so drawn as to protect the buyers against substitution of other coals, and at the same time was perfectly fair to the seller. Such specifications actually protect the dealer against unfair competition, as has been shown in many cases.

This plan will not be satisfactory, however, if the specification is carelessly drawn and the coal is selected on the basis of price without regard to its adaptability to the furnaces; nor will it prove satisfactory if the sampling is done by ignorant or careless men and the analysis made in poorly equipped laboratories by inexperienced chemists. Whether it will be advisable to purchase for a plant on this basis depends on the amount of coal used, the amount delivered at one time, the kinds of coal available and whether the purchaser and the dealers are qualified by a knowledge of the available coals to enter into a contract on this plan.

Some Details of Power Plant Smoke Stack Practice

By J. H. Williams

A Brief Sketch Enabling Operating Engineers to Become Familiar With Questions to be Considered and Rules Applicable in the Design and Construction of Smoke-stacks for Large and Small Steam Plants.

WHEN low first cost is essential, steel smoke stacks are often installed. They are either made sufficiently heavy to be self-supporting, or they are made of light plate and are supported by wire guy ropes.

Steel stacks soon corrode, and their only advantage over brick chimneys, in addition to low first cost, is that they oppose less friction to the flow of the waste gases.

Brick Chimney Design.

In designing brick chimneys and flues a great many points have to be taken into consideration. The chimney may be square, octagonal or round; the round shape being most common and offering least resistance to wind pressure.

The draft of a chimney varies directly as its area and as the square root of its height. For instance if a chimney, A, is desired to have twice the draft of another chimney, B, we can either make A twice as large in area as B, or four times as high. The height is generally determined by various conditions, such as local by-laws, etc., in which case, the area is made to suit.

Rough brickwork offers considerable friction to flow of the waste gases and allowance must be made for this. Experiments prove that this friction is approximately the same for all sizes of chimneys, and may be considered as equal to lining the chimney with an inert layer of gas 2 inches thick, having no velocity.

After calculating the theoretical area of any stack, therefore, we add four inches to the diameter to provide for this.

A common formula for finding the theoretical area required is:

$$A = \frac{1.5 \times G}{\sqrt{H}}$$

Where

A=Area of chimney at top or smallest part, in square feet.
G=Area of grate in square feet.
H=Height of chimney above fire-bars, in feet.

This rule assumes that about 21 lbs. of coal are consumed per square foot of grate area per hour. Where several boilers connect to one chimney the above formula may be modified as follows:—

$$A = \frac{G}{\sqrt{H}}$$

Many boilers are operating with good draft and a moderately high rate of combustion, where the area of the chimney opening is no larger than found by this rule.

Where the rate of fuel consumption is likely to be much less than 21 lbs. per square foot of grate area, the size of chimney opening may be calculated from the actual consumption by the following formula:—

$$A = \frac{.07W}{\sqrt{H}},$$

Where W represents the total coal consumption per hour in pounds. It is always as well to construct the chimney to take care of the maximum possible consumption, as the draft can always be regulated to suit a lower rate by means of the damper.

In any case the area should never be less than 1-10 the grate area, and is usually about $\frac{1}{8}$.

The height of the stack is frequently based on the fuel consumption as shown in the following table:—

Total Weight of Coal consumed per hour.	Height of Chimney.
100 lbs. and under	60 feet
500 lbs. and under	100 feet
1,000 lbs. and under	120 feet
2,000 lbs. and under	140 feet
3,000 lbs. and under	160 feet
4,000 lbs. and under	180 feet
5,000 lbs. and up.	200 feet

Suppose we have to design a chimney for four boilers, each of which has a grate area of 25 square feet and consumes 22 lbs. of coal per square foot of grate area per hour. Then the hourly coal consumption is

$$4 \times 25 \times 22 = 2{,}200 \text{ lbs.}$$

Referring to the table, we find that this

calls for a shaft 100 feet high, and the area required at top will be

$$A = \frac{G}{C\,H} \text{ or}$$

$$\frac{4 \times 25}{100} = 8 \text{ square feet (nearly).}$$

To find diameter that will give 8 sq. feet, $.7854D^2 = 8$ square feet.

$$D = \sqrt{\frac{8}{.7854}} = \sqrt{10.2}$$

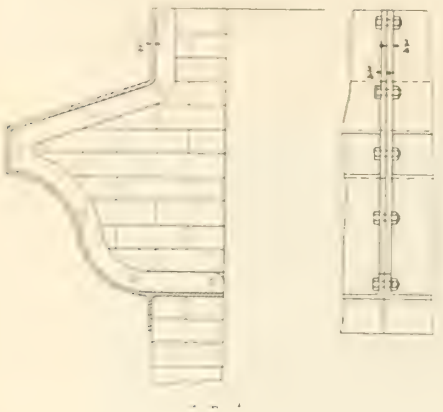
$D = \sqrt{10.2} = 3.2$ feet say 3 feet, $2\frac{1}{2}$ inches.

Adding 4 inches, for friction, we get 3 feet 7 inches as the diameter of our chimney at the top.

Brickwork Detail.

The brickwork at the top should be 9 inches for the top 25 feet, and should increase half a brick at each 25 feet going downwards. The chimney has not therefore a smooth bore from top to bottom, but consists of a series of off-sets. The batter of the shaft is usually about 1 inch to the yard, or 1 in 36.

The top may be finished off with a cap of brickwork or fire-brick blocks, or the cap may be made-up of cast iron



segments bolted together and filled in with brickwork, which is a common practice. A cast iron segment is shown in Fig. 1, and may be made to any desired contour, being cheap and easily set in position.

The chimney foundations should be carried down to the solid and should be spread out to form a good broad base, so that the load will not exceed $1\frac{1}{2}$ tons per square foot.

The foundation should be carefully levelled and should consist of concrete from one to three feet thick, according to the weight of the chimney and nature of the soil. Some builders line chimneys with fire-brick right to the top, but except in the case of small chimneys it is sufficient if the fire-brick extends from one-half to two-thirds of the height. The remaining distance must, however, be lined with sound hard brick. A copper lightning conductor, thoroughly well insulated from the chimney, is a paying investment, and climbing irons should always be fitted to facilitate inspection and repairs. A good plan is to build a

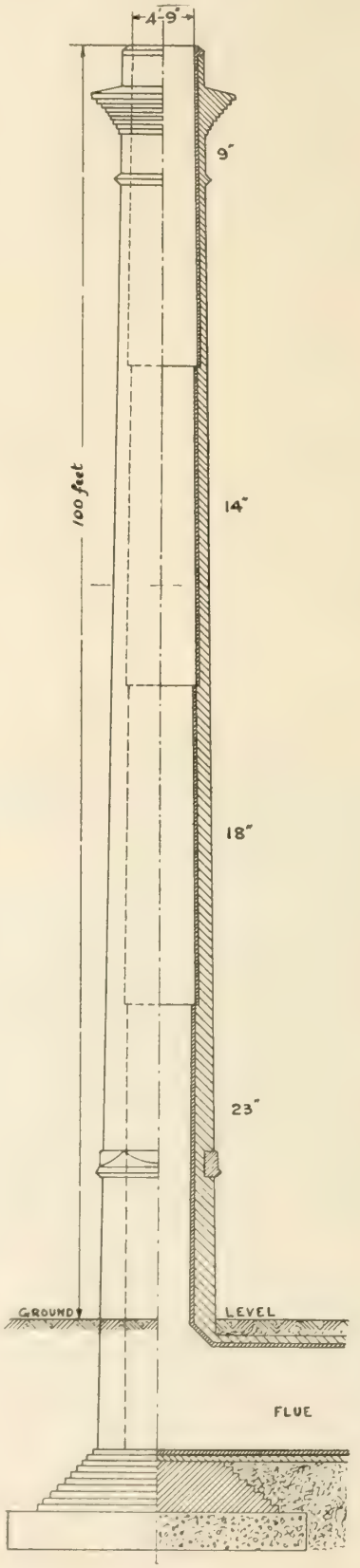


Fig. 2.

steel ladder on the outside of the chimney, of $\frac{7}{8}$ inch round iron. The rungs being 12 or 14 inches apart, 14 inches wide, and projecting about 10 inches from the chimney, so that a man can put his leg through and have his hands free, if necessary.

Serious cracks sometimes develop in chimneys, and may be due to poor workmanship, settlement of the foundation, or to age. Whatever the cause, they should be repaired without delay, as they may seriously affect the draft. In new chimneys, the actual draft is never equal to the theoretical, owing to leakage of air through numerous small crevices in the brickwork.

Fig. 2 shows a good example of a chimney, such as has been described. It is 100 feet high by 4 feet 9 inches internal diagram, and is lined with fire-brick throughout. The coping near the top is not of cast iron segments, but is formed by building out the brickwork. The cut clearly shows how the brickwork is spread out at the base in order to distribute the weight of the chimney evenly over the surface of the concrete bed.

Since concrete is cheaper than brickwork, the better plan would have been to carry the concrete bed up to the level of the bottom of the flue, this being now the usual practice.

SAFETY VALVES.

When installing a forced draft system to an already existing boiler equipment, careful investigation should be made of the capacity of the safety valves, for as compared with natural draft, the fuel consumption may increase 4 or 5 times more, and necessitate therefore a larger safety valve area.

In determining the area of firegrate on which to calculate the safety valve area, the length should be measured from the inner edge of the dead-plate to the front of the firebridge, and the width from side to side of the furnace on top of the firebars at their middle length.

Safety valves with a lip or overhang, provide a second contracted opening at the outer edge and operate as follows.

Immediately the valve lifts, steam fills underneath the outer rim, thereby increasing the effective area and causing the valve to open wide suddenly, in which condition it continues to vibrate on the spring, until the pressure falls so low as to be insufficient to raise it from the seat which it has touched in its movement.

Valves without lip or overhang are less violent in action and are favored generally on that account.

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Vol. IV JUNE, 1911 No. 6

THE TRAIN OF PROGRESS.

Are you aboard the "20th Century Limited Train of Progress," whose destination is self-betterment for all traveling with it, or are you still beating a passage along the ties? Such a question is applicable to the owners and operators of power plants, and its proper response means much to each.

The labor saving, yet increased labor opportunity and reward movement, has not made advancement in their case as it has done in the manufacturing or more strictly producing departments. Too much, has the power plant been considered a necessary evil, instead of a prime accessory by proprietors, with the result that all the conditions needful to encourage indifference of its attendants have had free scope. It seems to us that some attempt should be made to introduce "Welfare" work into this field. Success is attending its efforts in other departments, and we feel that equally good results would accrue from this. "Welfare" work as applied to the power plant, would cover men and equipment, and serve to bring about conditions and returns to all concerned, commensurate with the modernizing effort and energy put forth.

The pages of our journal will be found brimful of edifying information concerning the most modern progressive practice and requirement, and are at the disposal of all classes of our readers for ventilation of their needs and views in the direction of mutual helpfulness.

THE STEAM POWER PLANT AND ITS OPERATORS.

Advantage has been taken of this special Boiler Plant number of The Power House, to bring before our readers (the operators, superintendents, proprietors and designers of steam power plants) some recent leading authoritative pronouncements affecting future developments in the direction of higher efficiency and economy, and touching not only improved mechanism, but also improved quality and rating of the operating staff.

It has not been possible in the limited space available to include all of the many sections of the power plant field, and those forming the contents of this issue have for the same reason been more or less curtailed.

It will be noted however that increased attention is being given to intelligence of engineer and firemen operators; that fuel economy is becoming of paramount importance, and that as a result of the increased attainment which the already referred to intelligence will naturally have in the direction of economy, power plant operators will hold a higher rating, the quality of which will be that of graded fitness and capacity. The question of graded certificates is a live one with Canadian engineers, and needless to say is recognized as being their privilege to help secure, and their right to earn. We don't hesitate in giving unqualified support to this graded certificate movement, believing as we do that not only will a few be benefited, but certain that the profession as a whole will be raised to a higher standard of recognition (glorified and tangible) making possible sooner and perhaps more effectively, all and every scheme of power plant betterment.

A judiciously and moderately high-set examination for second and first class engineer, the successful passing of each of which in rotation at reasonable intervals from the existing standard as a basis, will inspire a proper sense of dignity and contentment, and have made the labor involved in its achievement worth while. We believe that graded certificates will, more than anything else, inspire and spur to effort what we are inclined to think is at present in the minds of engineers generally, a not too encouraging outlook for increased recognition of worth and rating.

LARGER CAPACITY TENDENCY IN STEAM BOILERS

The tendency to install larger boiler units in steam power plants is becoming increasingly more apparent daily. This applies more particularly to large manufacturing plants and central generating stations. For these, the water-tube with its flexibility and adaptation to additional and duplicated units in one setting, offers distinct advantages over the more or less limited return-tubular type. The advent and development of the water-tube boiler to its present high state of perfection has made possible more than anything else the large units to which reference is made, and been responsible for the wide gap existing between boiler capacities of a few years ago and now. The steam turbine has borne a not insignificant part in the demand for increased boiler capacity, there being installed in power plant engine-rooms, turbo-generators up to 14,000 K.W. capacity, whose natural requirement is of course equivalent boiler power.

As showing what has been done, one installations recently brought to our notice are briefly referred to. The Hartford Electrical Lighting Co. has installed a battery of four Bigelow-Hornsby boilers, which are rated at 1200 boiler-horse-power each, and in order to secure their efficient and economical firing, the American Ship Windlass Co. have built and fitted Taylor Gravity Underfeed-Type Automatic Stokers, which for this particular installation are the largest in the world.

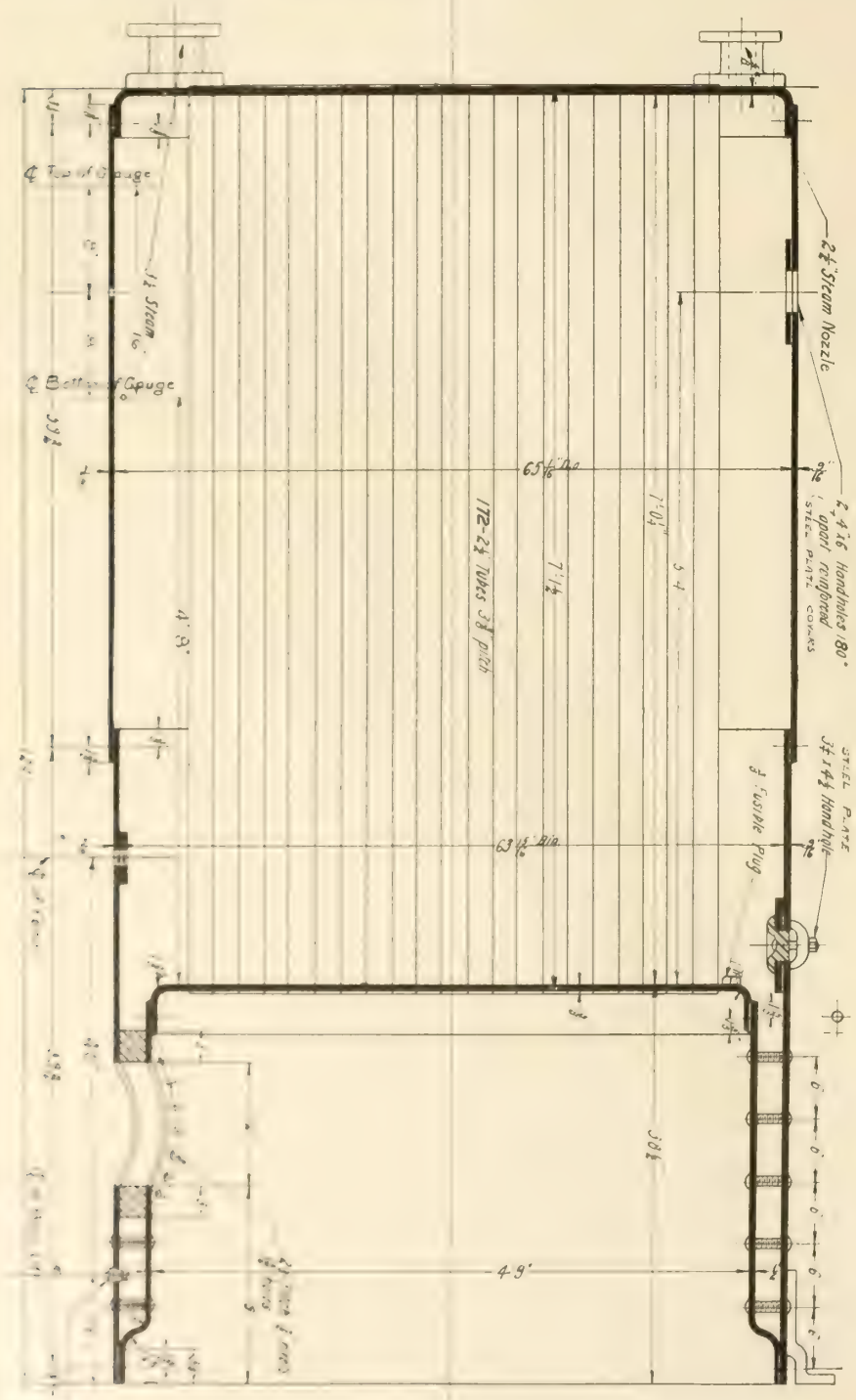
It is noteworthy that Canadian boilermakers are alive to this question of water-tube boiler growth, and are seeking by well-chosen design and workmanship to keep pace with the progress being made, and meeting the demand for small and large units as it arises. The series of articles on Canadian water-tube boilers we hope to continue in a succeeding issue.

Variety of Regulation Concerning a Vertical Boiler

By Intrepid

The Sketches and Description Refer to the Design and Detail Arrangement of a Vertical Boiler Submitted Respectively to the British Columbia and Alberta Boiler Inspection Bureau, and Serve to Show by the Want of Uniformity of Requirement to Attain a Certain Definite Working Pressure, How Immediate is the Necessity for an All-Canada Code of Boiler Rules and Regulations.

IN June of last year, the John McDougall Caledonian Ironworks Co., Montreal, prepared working plans for a vertical boiler, with a view to construction of same under a contract which called for installation in British Columbia. Leading particulars of the boiler are as follows : shell 65 1-16 inch mean diameter, total height 124 inches, shell thickness 9-16 inch, tensile strength of shell plates 60,000 pounds per sq. inch, shell riveting, longitudinal seams, treble riveted double butt strapped, $\frac{7}{8}$ inch rivet holes at 6.82 inches maximum pitch, girth seams single riveted lap joints, 1 1-16 holes, $2\frac{3}{8}$ inch pitch. The inner butt straps on the longitudinal shell seams are $14\frac{3}{4}$ inches wide by 7-16 inch thick, while the outer butt straps are $9\frac{3}{4}$ inches wide by 7-16 inch thick. The tube plates are $\frac{5}{8}$ inch thick, and there are 172 tubes, $2\frac{1}{2}$ inches diameter, $3\frac{3}{8}$ inch pitch. The firebox drum is of $\frac{1}{2}$ inch plate secured to shell by screwed stays with rivet heads on each end.



Sectional Elevation, the McDougall Vertical Boiler.

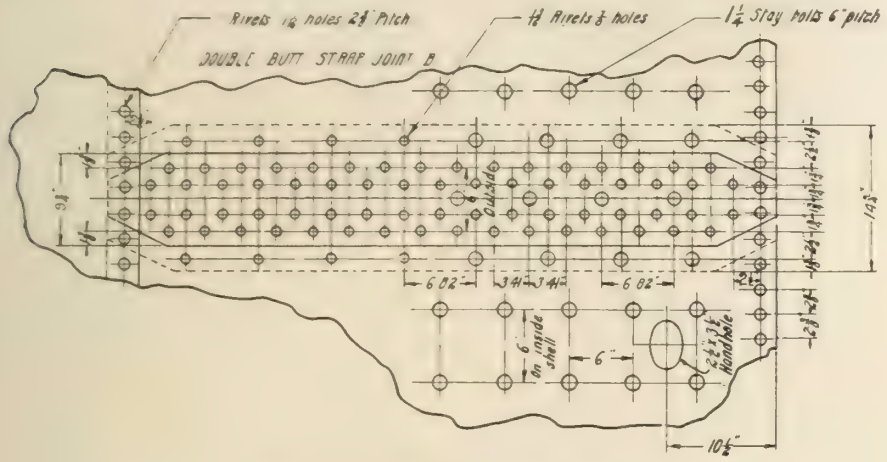
On submittal to the British Columbia boiler inspector for approval, consent was given to the adoption of the constructional detail for a working steam pressure of 159 pounds per square inch if built without inspection, and to a working pressure of 196 pounds per square inch if built with inspection.

On submittal to the Alberta inspector for approval some two months later on another similar contract the following additions were required, and the working steam pressure determined as 173 pounds per square inch without inspection. A $\frac{3}{4}$ inch screwed plug to be fitted under firedoor, furnace drum staybolts increased from $1\frac{1}{8}$ to $1\frac{1}{4}$ inches diameter, $3\frac{1}{4}$ by $4\frac{1}{2}$ inch handholes to be reinforced, 4 by 6 inch handholes at fire line to be added and reinforced, feed connection to be reinforced, and rivet holes to be punched 3-16 inch instead of $\frac{1}{8}$ inch under finished diameter, for reaming out in place.

The changes required by the Alberta inspector and on account of which an additional 14 pounds per square inch working pressure was attained without inspection, are more or less trivial except in the matter of handholes, for all such boilers should have four handholes located at the water line, the furnace crown or lower tube sheet level, and as low down as possible in the pocket formed by the offset furnace drum and shell joints. The difference of 1-16 inch in the punched rivet hole diameter is of little consequence, although reinforcement of handhole and other openings should be considered desirable practice.

What strikes us most forcibly in the matter of this particular boiler, or of any other under similar conditions, is the question of inspection or non-inspection, and the end to be attained therefrom. We think the practice of building a boiler to get or take the best pressure

available under or without inspection, is altogether wrong, and the idea of having to conform to every individual city, local district or provincial set of rules does not do credit to the boiler construction and universally adopted professional knowledge available. A boiler should be designed for a specific purpose, and being so will attain a certain working pressure value. That working pressure should be attainable on an inspection basis and should leave no room for widely varying amounts being adopted. Inspection should be insisted on from the rolling of the plates until the boiler ceases its service, and no reputable maker would risk his business honor, by nonfulfillment of the constructional requirements called for to the utmost limit.



Riveting, the McDougall Vertical Boiler.

There is too much variety and localization of boiler constructional detail rules and requirements, a condition of affairs militating more or less against fair competition. A uniform set of boiler by-laws in operation throughout the Dominion, would ensure against uncertainty of attainment of definitely sought ideals without unnecessary delay as at present, would facilitate drawing office work and records, and place manufacturers in a position less liable to the possible whims of individual inspectors. The cost of conforming to one standard set of rules would probably make itself felt to the boiler purchaser, still he would have the satisfaction of knowing that the possible additional safety assured was a return of ample value.

The boilers forming the basis of this article are simply an example of everyday experience, and while their different attainment of pressures was on account of the different requirements of two adjoining provinces, more marked still are the differences to be found in the regulations of some large cities as compared with their immediately surrounding district rules or those of other cities in the same province.

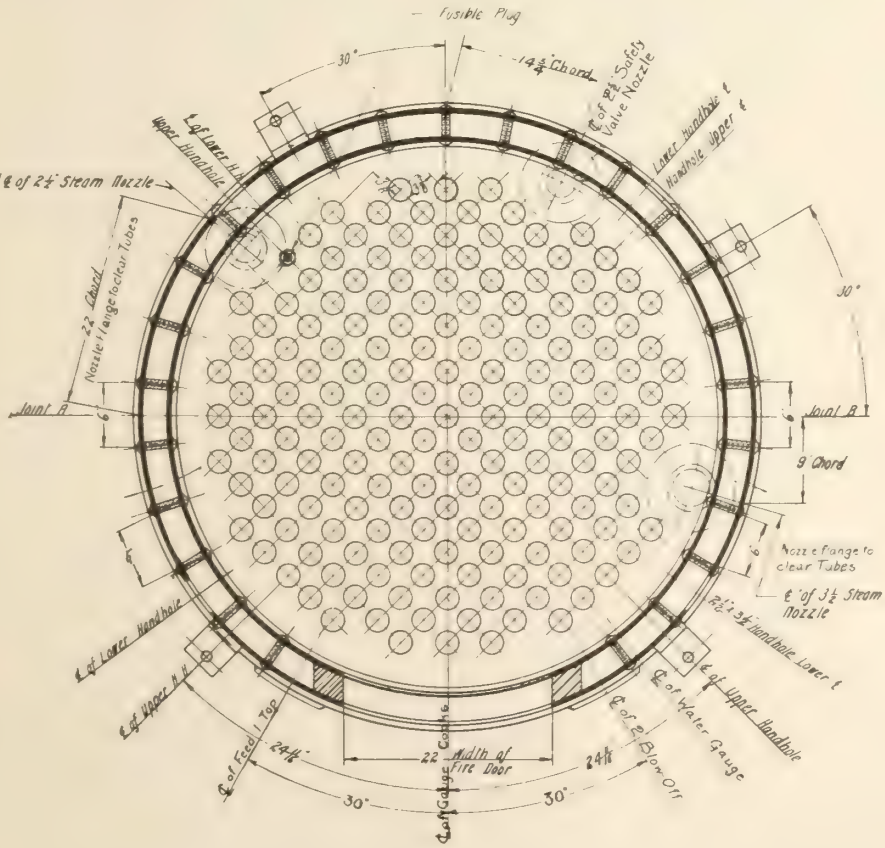
We have drawn attention to the question of the advisability of securing a Dominion boiler law, in the hope that those interested will give voice to their opinions on the subject, freedom of our pages to discuss which, is at their service.

AUTOMATIC STOKING.

Reference has been made in our editorial columns to the tendency towards large boiler units, a condition calling for development in and increased necessity for automatic mechanical firing.

It is significant that the Hartford Electric Company operated the first two of its 1,200-H.P. units by hand-firing for some time, but when it was decided to install the other two units, not only were they equipped with underfeed stokers, but the original installation was also changed over. To successfully fire either very large or moderate sized units under heavy overloads, as is now generally considered good practice, hand-firing cannot be relied upon. A form of stoker is necessary which combines several requirements by no means easy of attainment. The stoker must of necessity be supplied with air by forced draft, as heavy overloads mean rapid combustion, and this can be obtained economically, only with forced draft. Provision for thoroughly coking the coal before it is actually ignited should be a part of the design of the ideal stoker, and another important requisite is that it shall not be necessary to clean the fires by hand; a process which results in checking combustion and cooling off the boiler from the inrush of cold air.

By means of automatic firing, overloads of 50 to 100 per cent. are being obtained regularly in practice, and it is probable that future boiler unit developments will take place along this line. How far further increase in size can be carried is difficult to predict. It seems probable that a combination of large units with very heavy overload capacity is likely to be the ultimate result, but whatever the final answer to the boiler problem, it seems fairly certain that au-



Sectional plan, the McDougall Vertical Boiler.

automatic stoking will have a great deal to do with the solution.

The present crusade against smoke has been the means of changing more than one boiler plant from hand-firing to the use of automatic stokers, and a stoker designed to coke the coal and burn its hydrocarbons completely will operate smokelessly. In accomplishing this important function of automatic stoker firing, the underfeed principle has proved highly satisfactory, particularly at high rates of combustion. The coal is heated very gradually and the distillates must pass through the white hot zone of the fire itself, before they can possibly reach a cooler area. Thorough combustion is bound to result and with it an utter lack of smoke, regardless of how high the volatile constituents of the coal may be, provided the air supply is properly regulated. The fixed carbon being automatically pushed up into the fire bed becomes gradually heated and eventually burns. Of course to increase the proper working out of such a system as this, it is essential that the supply of air should be at all times and at all loads properly proportioned. If too much air is admitted there is a large amount of waste due to the necessary heating up of this excess. If too little air is present it is impossible to burn the hydrocarbons thoroughly, and an excess of smoke and carbon monoxide is the result. Accordingly, for ideal combustion the amount of excess air for the coal to be burned, should be carefully determined, and once this is done, the stoker itself should automatically adjust these conditions to every condition of load.—Eng. Digest.

Series of Practical Questions for Answer by Engineers

By E. B.

Every Care Will be Taken to Select Practical Questions Arising out of an Engineer's Daily Routine; the Intention Being Thereby to Make the Series More Interesting and Valuable From an Educational Standpoint. Arithmetic up to the Multiplication and Division of Decimals, and the Extraction of the Square Root of a Number, Will Cover the Calculations Necessary to Fully Answer Questions Calling for Arithmetical Treatment.

The series of practical questions and answers for engineers has been discontinued in its previous form for the present, and this new series substituted. Our idea in making the change, is to give our readers an opportunity of studying out the problems for themselves, to encourage them to put their ideas on paper for publication, and to give us an idea as to what extent the previous series was beneficial. Contributions of questions to this department will be welcomed, and correct answers will be published in the correspondence section of each succeeding issue of The Power House.

Q—1. Calculate the horse-power of a single cylinder engine with a cylinder diameter of 26 inches and a stroke of 48 inches, making 73 revolutions per minute if an average indicator card has an area of 3.82 square inches and a length of 4.75 inches when taken with a spring of 40 pounds to the inch. The diameter of the piston rod is 4 inches.

Q—2. Draw an indicator card marking the points of admission, cut-off, release and compression. Make the cut-off at one quarter stroke and show a line for the pressure of the armosphere.

Q—3. A direct acting steam pump develops 15 horse-power in the steam cylinder. If the pump has an efficiency of 60 per cent., how many pounds of water will it raise per minute through a height [illegible]

Q—4. What is the theoretic capacity in gallons per minute of a direct acting steam pump with a steam cylinder 12 inches in diameter, a water cylinder 6 inches in diameter, an 8-inch stroke and making 60 single strokes per minute? (231 cubic inches equal one gallon.)

Q—5. Sketch a valve and seat for a plain slide valve with a half inch outside lap and an eighth inch negative inside lap. Show the valve in position for crank end cut-off. Indicate which way the valve is moving and the end of the cylinder which is toward the crank.

Q—6.—If a slide valve engine gives a satisfactory indicator card with 45 degrees angle of advance of the eccentric, how far must the eccentric be rotated to reverse the engine and give an equally good card when running in the opposite direction? Show by a rough sketch.

Q—7. Name some of the principal advantages to be expected from compounding a steam engine, giving the reason for such.

Q—8. How many pounds of condensing water per minute will be needed for an engine exhausting 160 pounds of steam per minute at a pressure of two pounds absolute? The cooling water enters at 70 degrees F. and the mixture leaves at 120 degrees F

Q—9. Sketch some form of jet condenser. Should the cooling water be supplied under head or drawn in by air pump? Why?

Q—10. What is the gain to be expected from the use of a condenser? State two conditions where a condensing plant should not be used. What vacuums are ordinarily used?

Q—11. Calculate what horse-power a 16-inch double belt over an engine fly wheel 12 feet in diameter and making 85 revolutions, would safely transmit.

Q—12. Explain the action of an injector. Why do injectors fail to work with hot water?

Q—13. What is the rated horse-power, as near as you can estimate it, of a 66-inch return tubular boiler 16 feet long, with 96-3-inch tubes?

Q—14. Describe how you would proceed to bank a fire, and how you would start up a banked fire.

Q—15. Why is theoretically perfect combustion not practical in a boiler furnace, and why is air excess necessary? About what per cent. of air excess is it wise to allow, and what is the effect of this on the efficiency?

Q—16. Why is circulation necessary in a boiler? Explain fully what causes it.

Q—17. What is meant by "priming" of boilers? Explain fully its causes and means of prevention.

Q—18. What is meant by a British thermal unit? Explain briefly what you understand by the latent heat of steam; total heat. Are they both constants?

Q—19. Why should a water column be blown? How often? What would you do when under steam if water column or try cocks showed no water?

Q—20. Describe one type of feed-water heater and make sketch of same.

John H. Cooper, in Volume XIV, of the Transactions of the American Society of Mechanical Engineers, stated: "Inscribed upon an ancient crest of a pick axe are the trenchant words, 'Either I will find a way or make one.' A good motto for an engineer, but his work is not done till he publishes how he did it." The last statement is as forcefully true to-day as it was 20 years ago when first spoken.

Just because warm weather is coming is no reason why you should close your books and let your studies go for another six months.

ELECTRICITY FOR STATIONARY ENGINEERS

CONCERNING DYNAMOS AND MOTORS.

By Nicholas Kinsella.

THE care and operation of dynamos and motors is an important duty of [illegible] engineer or electrician under whose supervision the successful operation of those machines depends, and nowadays, says the "Southern Engineer," the engineer is oftentimes his own electrician.

When the voltage fluctuates, it is a sign that either the plant is overloaded or something has happened. Assuming that the plant is working under normal conditions and the voltage is not constant, one of the following troubles may be looked for. First, loose brushes in the brush-holders or light brush contact against the commutator; loose joints or connections; weak springs that are not sufficiently strong to feed the brush against the commutator bars; uneven commutator surface or the surface covered with a film of oily matter. All of these will tend to lower the voltage. When the voltage drops without any apparent cause, such as load, speed, or other apparent reason, the brushes and commutator should be sandpapered, to remove the thin film of non-conducting material which will be found between the brushes and commutator, and which lowers the voltage. While it is desirable to have the commutator covered with a brown glaze, still this surface should be removed occasionally, in order to hold the voltage at the desired point. There is always a rise in voltage when the commutator and brushes are properly sandpapered.

At present dynamos are so wound that there is hardly any sparking from no load to full load, but at times sparking will occur with the best-constructed machines, and when it cannot be removed by trying the known remedies, then there is every likelihood of commutator trouble. Should sparking appear, it will be noticed by reason of two or more burned bars at some point in the commutator surface. In such a case, sandpapering of the commutator will only increase the trouble. The correct remedy is to have the burned bars reinsulated and the corresponding coils rewound, because in nearly every case of burned bars the coils will be found bad. Heavy sparking at a particular brush is an indication of an open circuit in the armature coils, and this is denoted by a rapid wearing of those commutator bars which belong to the open coil. The only correct remedy is the one previously mentioned.

When it becomes impossible to do this, there is a way to stop the sparking. It can be done by soldering a piece of wire or flat copper bar across the burned or injured bars, and closing the coil with the next good coil. This at best is only a makeshift, although it may be found expedient sometimes in order to keep the plant running until proper repairs can be made.

Motor repairs are almost identical with dynamo repairs. There are, however, some things met with in the operation of motors that seldom present themselves in dynamos. In general, dynamos are direct driven, and the strain and wear on the bearings is evenly divided. With motors this is reversed, because the motor must pull on the pulley side, and consequently the belt strain throws the armature out of alignment and gradually destroys the clearance. This is the result of wearing of the motor bearings. In testing for clearance it will be noticed that this is least in the direction of belt strain or pull. If wear be allowed to continue, the result will be an injured armature, because the armature will trike or rub agains the horns of the pole pieces, and either wear off the binding bands or cut one or more of the armature coils. It is important, therefore, to watch the wear of the bearings and not allow it to permit the armature to strike or rub against the poles.

When testing for clearance always use a strip of metal of sufficient thickness to pass between the armature and pole pieces, and when this strip cannot pass it indicates wear. When we know the armature is approaching the poles we may make preparations for the renewal of bearings at a time when the motor is not needed. Another way to test for clearance is to place a lamp at one end of the armature and sight through. In this way we may quickly determine the amount of clearance.

A MOTOR EXPERIENCE.

By Leonard Work.

Electrical machinery is frequently reported as failing to perform its work properly, when the real difficulty lies entirely outside of the apparatus itself. One such case happened not long ago where a two-phase induction motor was installed to operate a vertical coal elevator, replacing an old gasoline engine. The new motor, which was one of the latest type, looked very promising, but had hardly been started and the conveyor buckets filled with coal before it gave evidence of distress, slackened its speed, and stopped. It could not be started again, and finally the purchaser, impatient at the delay, threatened immediate rejection of the motor and the installation of another engine.

An engineer was sent for, who on arrival, made inquiry as to the voltage and frequency of the service line, but was assured positively by the superintendent of the local power plant that the voltage and frequency were unquestionably correct and were always so maintained, but that the motor was obviously at fault in that it would not pull a load which a five horse-power gasoline engine had carried, although the motor was of twice that capacity. Examination of the motor failed to show the slightest disorder with its windings or connections. All its circuits were clear, and although of ample capacity, it was conceivable that in some manner the load might have become too heavy. In an endeavor to diagnose the case, it was decided to make several measurements and determine the torque necessary to start the load, the available starting torque, the frequency of the circuit and the line voltage.

It is commonly thought that measurements of this kind require an array of laboratory instruments, or other special facilities; however, all the necessary data was obtained here with a spring balance from an ice wagon, a speed-indicator and a voltmeter; and this simple paraphernalia served to locate the trouble very quickly. The torque required to start the load was obtained by attaching the spring scales to the driving belt and pulling it slowly along, thus moving the entire load, whereupon the pointer indicated a pull of 120 pounds. The product of the motor speed times circumference of pulley gave the belt speed as 1,600 feet per minute; this multiplied by 120 pounds and divided by 33,000 gave 5.8 as the horse-power required at full speed, which proved that the motor was far from being overloaded. Next, the motor starting torque was measured at one foot radius. For this purpose a wooden bar was fastened across the diameter of the paper pulley

and a notch was made in the bar exactly one foot from the center of the shaft, so that the hook of the scales would remain at the stated distance. The scales were then so suspended that the projecting bar would maintain a horizontal position while resting on the hook. When current was applied to the motor, the pointer registered a pull of 41 pounds, which was at about one-half the normal rated starting torque for the motor.

The cause of such a low torque would be either high frequency or low voltage or both, and steps were taken at once to ascertain these values. The first step in determining the frequency of a circuit by means of a motor is to know its no-load speed, when the full-load speed is given. The rated speed as given on the motor name plate was 850 revolutions at full-load and 7,200 alternations per minute. The synchronous speed is found by dividing the rated alternations per minute by the number of poles; the next highest number above full-load speed obtainable by dividing the alternations by an even number will be the synchronous speed, while the divisor will be the number of poles. In the present case, 900 is the next highest number above 850 obtainable with 7,200, and with eight for a divisor; hence the motor was obviously an eight-pole machine, with a no-load speed of about 900 r.p.m. on normal frequency.

With belt off, the motor was given full line voltage. The speed indicator showed 1,000 revolutions per minute, which being above synchronous speed, proved that the frequency of the circuit was high in the proportion of 1,000 to 900, or 11.1 per cent., and, since the starting torque of an induction motor, within certain limits, varies almost inversely as the frequency, this was evidently one cause contributing to the weakness of the motor. There remained only the question of line potential. A voltmeter applied to the motor terminals, with the auto-starter in running position, showed the voltage to be 154, whereas the motor was rated at 200 volts.

The whole cause of the trouble was now apparent, and, accordingly, measures were at once taken to correct the abnormal conditions. As soon as the frequency was lowered to the correct value and the voltage raised to normal, the motor started up and pulled its load in such a business-like way and with such evidence of reserve power that it thoroughly redeemed itself.—Electric Journal.

Power Plant Troubles, Happenings and Improvements

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

PUMP CONNECTIONS.

By Joseph W. Hayward, M.Sc.

More lives are spoiled by little worries than by big troubles. Many a man who could bear the loss of a thousand dollars without opening his mouth, will tinge blue with profanity the atmosphere of his whole house, over a broken collar stud. The little worries about a power [illegible] as bad as the rest, and since not a few of them arise from a bad arrangement of the piping for pumps, the writer proposes to give a few pointers with regard to this matter. People who ought to know better often lay down these details quite incorrectly. For example, a presumably capable steam engineer was once testing a condenser; it was of new design and he was going to condemn it because it had sprung a leak during every test. A hydraulic man came along, looked at it, measured up the water piping, did some figuring on his shirt cuff, and remarked: "There is a pressure of thirty pounds per square inch on the water side in there." The steam man was sceptical till a gauge was put on to prove it. Larger discharge connections were afterwards set up and all trouble ceased.

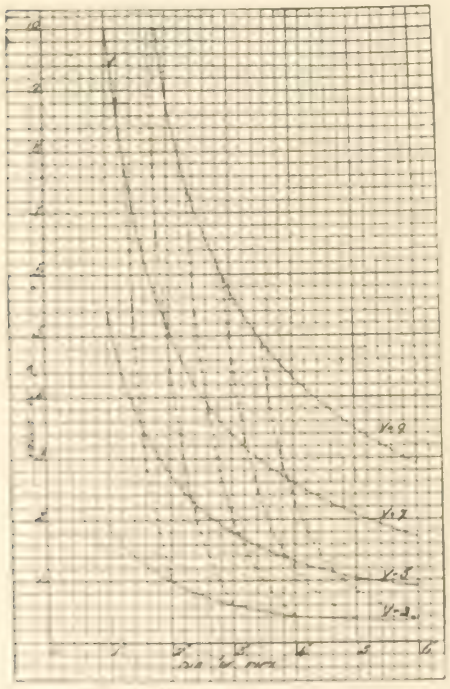


Fig. 1.—Pressure loss diagram.

Even for the smallest of water piping the following rules should always be adopted:

1. Don't let the average velocity of the water in the pipes exceed five feet per second.

2. Avoid sharp elbows and sudden changes of section.

3. Have large air vessels on both sides of every reciprocating pump.

The size of piping required to satisfy rule 1 in any particular service can be found as follows:

d=Diameter of pipe in inches.
D=Diameter of pump in inches.
L=Stroke of pump in feet.
N=Strokes per minute.

$$d^2 = \frac{LND^2}{300}$$

Take twice this value of d for a duplex pump and about two-thirds for a single acting one.

Loss of Pressure

The loss of pressure in straight piping of reasonably smooth bore is given by the formula,

$$p = \frac{1}{465} \times \frac{LV^2}{d}$$

Where p=reduction or loss of pressure in pounds per square inch, in a length of L feet of piping, d inches in diameter, when water passes through it at the rate of V feet per second.

The full curves in figure 1 have been derived from this formula to show the losses of pressure per hundred feet of piping, for velocities of 3, 5, 7 and 9 feet per second The dotted curves have been added to show the loss in pipes of various sizes, for a constant total discharge. Thus, a velocity three feet per second in a six-inch pipe gives the same discharge as a velocity of nine feet per second in a three and one-half inch pipe with less than one-twelfth of the resistance. Water is a heavy inelastic substance, hence, any sudden change in its speed or its direction of motion will cause shock or loss of energy. That there is little or no loss in passing it through

the long, tapering nozzle of a fire hose, or around a pipe bend of more than four diameters in radius, is due to the changes occurring gradually in these cases. Air vessels act as springs to compensate for the rapid changes in velocity of a reciprocating pump plunger, and reduce the resultant changes in speed of the water pumped Some variation is unavoidable, and must also be introduced at all joints, branches and valves in the pipe line By reducing the shock at these latter points, an intelligent engineer may secure some economy and avoid much annoyance. The loss caused by sockets, elbows, etc., is best expressed by stating, in diameters, the length of straight pipe which causes the same resistance. This length reduced to feet, can be added to that of the straight piping to obtain a total from which the whole resistance of any system can be computed by a single application of formula 2. Thus, a socket joint in a two-inch pipe causes the same resistance as $2 \times 24 \div 12 = 4$ feet of straight pipe, an elbow as $2 \times 60 \div 12 = 10$ feet, and so on.

A table of such resistances, as determined by professor Goodman is appended.

Nature of Resistance.	Equivalent length of straight pipe expressed in diameters.
Right-angled elbow	50 to 60
Right-angled bend of 4 diameters radius.	3 to 5
Sockets (screwed)	24
Sudden enlargement or contraction	10 to 15
Mushroom valve	120 to 150

SIGHT FEED LUBRICATOR OPERATION.

The operation of Sight-Feed Lubricators depends upon the action of natural laws, therefore unless some part is injured or defective, or some mistake is made in attaching or operating, they must work as positively and as certainly as water will run down an incline. By reference to the accompanying cuts, detail of operation can be easily understood. The pipe P, shown in sectional cut on the right, connects with a passage from condenser A-2, so that as soon as the water feed valve A-4 is opened, the water in the condenser will pass down the pipe P, to the bottom of the body of the lubricator, and being heavier than oil, will stay at the bottom, the oil floating above it. The pipe S leads to the lower sight-feed arm from the upper part of the body of the lubricator.

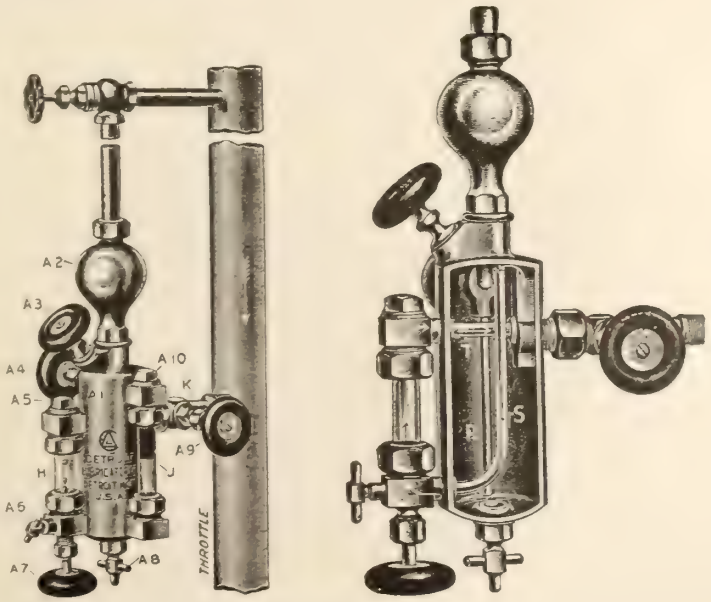
The body A-1 is filled with oil. Steam from the main steampipe passes in the connecting pipes above the lubricator and condenses, filling the condenser A-2 and part of the pipe above it with water. The steam also passes into the support arm and through the internal tube T into the sight-feed glass, where it condenses, filling the glass with water. As soon as the valve A-4 is opened, the oil in the body of the lubricator is subjected to the pressure of the column of water extending through the pipe P, the condenser and part of the pipe above it, amounting to about 2 lbs. to the square inch, and in addition to the pressure of the steam above the water, amounting to say 100 lbs. to the square inch, or a total pressure of about 102 lbs. to the square inch. This we may call the positive pressure. Liquids communicate pressure equally in all directions, so the oil in the body of the lubricator will press in every direction with a force of about 102 lbs. to the square inch. It will therefore press down through the tube S with this force of 102 lbs. to the square inch. Then, if the valve A-7 is opened, a force acting in the opposite direction is encountered, which we may call the back pressure. When the lubricator is connected as shown, this back pressure will consist of the column of water in the sight-feed glass, and in addition, the steam pressure back of this column entering through the support arm, and amounting to 100 lbs. to the square inch.

The positive steam pressure being just the same as the back steam pressure, these two forces will neutralize each other other, and we have left, the positive pressure of the column of water extending through the pipe P, the condenser and part of the pipe above it, and the back pressure of the column of water in the sight-feed glass. As the latter is much less than the positive pressure, the drop of oil is forced through the nozzle. As soon as it leaves the nozzle it is no longer acted upon by the positive pressure, and it rises through the water in the glass from the force of gravity, it being lighter than the water. After rising through the sight-feed glass it floats through the tube T and through the support arm into the main steampipe and goes with the current of steam to the steam chest and cylinder. The positive pressure must always be greater than the back pressure, or the lubricator will not work. For instance, if a lubricator be connected to a horizontal steampipe by being suspended below it, the back pressure would be greatly increased, and in order to get sufficient positive pressure the condensing pipe should rise 18 in. to 24 in. above the horizontal steampipe and then descend to the condenser. This will give a column of water for positive pressure higher than the column of water which acts as back pressure.

The writer is indebted to the Detroit Lubricator Co., for the cuts accompanying this article.

AN ENORMOUS BATTERY.

A huge storage battery is being built for the light and power company of Baltimore. The entire weight of the battery will be 540 tons, and it will be able to furnish 3,000 kilowatts per hour when fully charged. The battery will consist of 152 cells, each 150 inches high, 21.75 inches wide, and 6 feet long. Without the plates and the electrolyte the weight of each cell will be 940 pounds. Each cell will contain 133 plates.



The Detroit Sight Feed Lubricator.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

SOME EASILY MADE REDUCING MOTIONS.

By S. K. B.

This is a continuation of the article in our May issue, and in addition to referring further to the mechanism Fig. 2 already shown a description of other arrangements of reducing motions is given.

In Fig. 2 the cord is attached to the bar O, at the point B, which must be

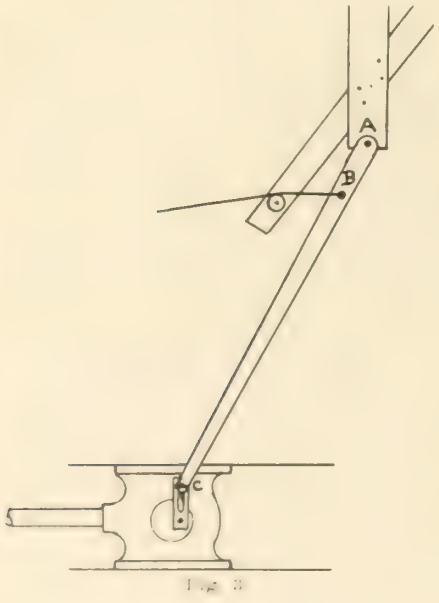


Fig. 3

in a direct line with the points A and C. What has been said with regard to the points of the "lazy tongs," will also apply to the pantograph. The length of diagram that a pantograph will give from a certain engine is equal to the length of the stroke multiplied by the distance AB, and divided by the distance A C.

While the two motions just described are correct, they are apt to spring at high speeds, and the joints, therefore, soon wear loose, and make errors in the diagram. For high-speeds generally a reducing motion called the "swinging lever" is used, of which there are a number of types; but as they all act on the same principle, only two will be described here. Fig. 3 shows a lever which if carefully made, will give excellent results. The lever should be made as long as convenient, not less than twice the length of the stroke. The pin C in the lever works in a slot, which is cut in a piece of iron bolted to the crosshead, and should be a good fit, with no lost motion. The practice of placing the pin on the crosshead and the slot in the lever, as in Fig. 4 is not to be recommended, as the distance A C is changing, while the A B is constant, and gives different ratios of reduction for different parts of the stroke. There will still be a very slight error, due to

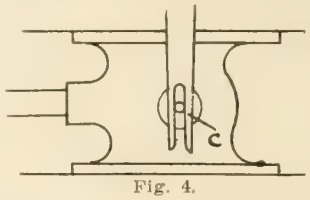


Fig. 4.

the pin B traveling in an arc, but with a long lever this will make little difference for ordinary work. The point A should be so placed that when the crosshead is in the centre of its travel, the lever will be vertical. To find the distance A B for a given stroke and diagram, multiply the distance A C by the length of the diagram and divide by the length of the stroke.

Fig. 5 shows another form of lever in which the motion of the crosshead is given to the lever by a link L; otherwise it is the same as Fig. 3. The error here is in the angularity of the link, which acts in the same manner as the connecting rod of an engine, and the longer the link is made, the less the error. It should never be less than 1-3 the stroke.

The point A should be placed so that when the crosshead is in the centre of its travel, the link will be horizontal

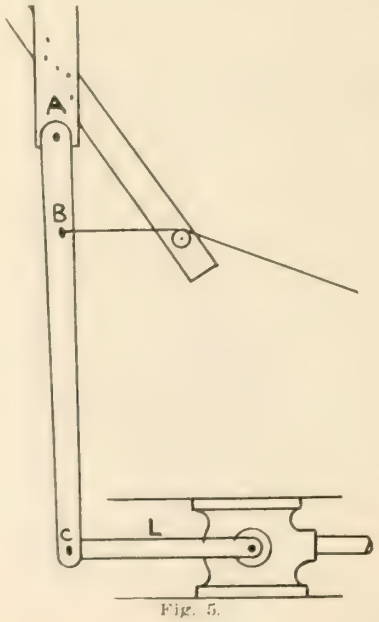


Fig. 5.

and the lever vertical. However, it gives results near enough except where close calculations are to be made from the diagram. It can be made correct by taking a little more time, and accurate calculations are assured from the cards. Remember that there is a no more consistent liar than a poor or improperly connected indicator. There are a few things to be remembered. Have no lost motion in the reducing rig, but still have it work easily. Run the cord, which should be of braided linen, as direct as possible, and have it leave

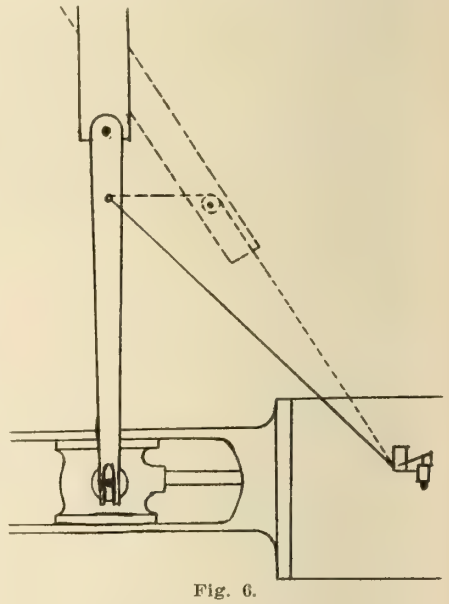


Fig. 6.

the reducing motion straight, as in the dotted lines, Fig. 6. The full lines show how an engineer first put it up and took a card, showing his valves to be wrong. He reset them until he obtained a card which looked good, and then spent the rest of the day wondering what ailed that "ding busted" belt.

POWER AND HAND TUBE CUTTER.

By Frank C. Perkins.

The illustrations, Figs. 1 and 2, show the details of construction and indicate the method of operation of a labor and time-saving tool designed for removing defective tubes from water or fire tube boilers. When driven by power a flexible shaft is connected to the tool as indicated in drawing Fig. 3 and illustration Fig. 4, the principle of operation being the removing of a very small section of the tube instead of forcing the tube apart with the bevel wheel cutter as in the usual practice.

It will be noted that Fig. 1 shows the cutter inserted in tube A to be cut, 11 being the body of cutter which holds the cutter in place in tube and 10 a spindle attached thereto upon which the cutter head 20, carrying the saw, rotates.

It will be seen that 24 is a sleeve, pivoted at its outer end, carrying the saw arbor 30 and the saw 31 is a small metal slitting saw which cuts the tube. On account of the cutting action of the saw on the tube, the cut being from the outside to the inside leaves the tube with no burr on the outside and does not expand the tube—which will permit the tube being withdrawn through the hole in which it was expanded.

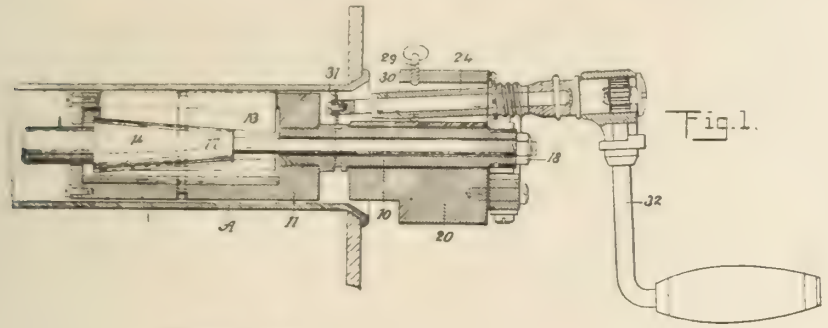


Fig. 1.

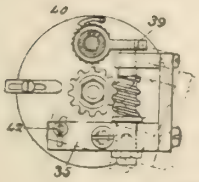


Fig. 3.

Details of Hand Tube Cutter.

It may be stated that in using the cutter the saw must be down even with outside diameter of body. Then the cutter is inserted in tube so the saw will cut the tube the distance inside the head required. The nut on end of spindle is then screwed up and clamps the cutter rigidly in tube by means of the conical block and clamping plate. The thumb-screw 42, noted in drawing Fig. 3, is then loosened, the frame 35 which carries worm wheel 39 is swung out of mesh with 40, after which the thumb screw 42 is tightened.

The cutter is rotated by means of ratchet handle and while so doing the wing nut on side of head is turned to right until the sleeve which carries saw arbor comes in contact with screw on top of head, which will have fed the saw up through the tube.

By turning the thumb screw 29 down on the sleeve, it will hold the sleeve rigid, and the frame 35 is swinging so that worm wheel 39 and 40 mesh, by rotating the saw arbor, it will now automatically feed the saw circumferentially around the tube and finish the cut.

After one end of a tube has been cut there should be a round block of wood a little less in diameter than inside of tube, inserted in the end cut to support the tube while the other end is being cut, which will protect the cutter from any damage by the tube dropping down. After both ends of the tube are cut the small pieces of tube are removed and tube can be drawn through the hole.

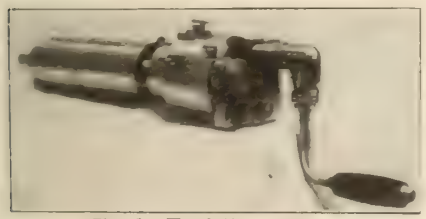


Fig. 2.—Hand Tube Cutter.

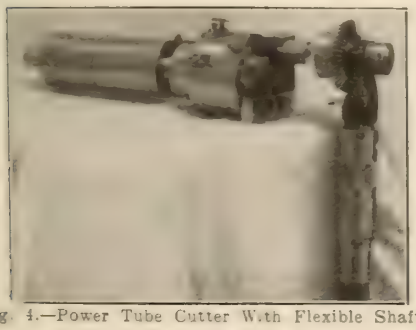


Fig. 4.—Power Tube Cutter With Flexible Shaft.

ELECTRIC HEATER FOR STEAM BATH.

By Elvin F. Brough.

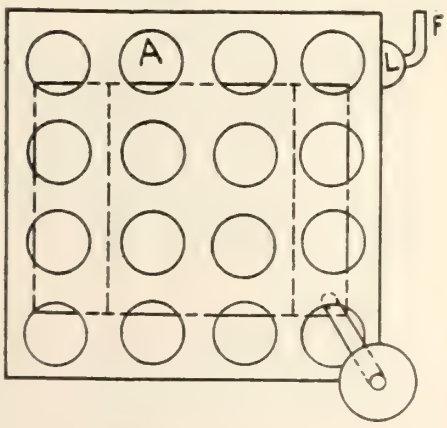
The chemical manufacturing plant where I am employed as electrician, having entirely replaced steam by electric power, found it necessary to provide an electrically heated steam bath for the laboratory. Instead of using a commercial immersed coil to heat same, I designed and made one which is giving excellent results. The accompanying sketch of the complete bath will perhaps be of interest to others having need of one similar.

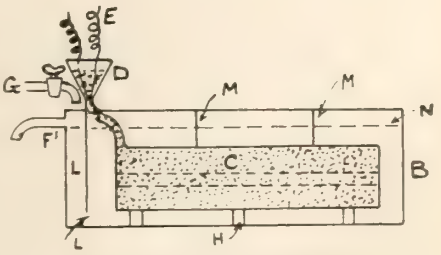
The outside water box, 28 inches sq. and 8-in. deep, is made of 8 lb. lead. The top is burned on, and has 16-4½ inch holes in it. The heater tank also made of lead is 21 by 25 by 3 inches, and contains the heating spirals which are made of No. 18 tinned iron wire, wound on a ⅝ inch mandril. There is about 50 feet to each spiral, which wound tight, takes about 14 inches on the mandril. The coils were stretched out on a wood rod to 23 inches. Ten of these spirals are held in place by a wood frame and placed inside of the heater tank which is sealed up, leaving only an opening for a 1-in. pipe to bring the leads out through and also to allow for the expansion of the transformer oil with which the tank is filled.

The tank is set on legs 1 inch high in the middle of the water box, and a 1 inch pipe is brought out through the corner of the lid and terminates with a funnel-shaped end. The water box is filled to a level about 1 inch above the heater tank, and kept so by a small constant supply running into the inlet chamber.

When the "juice" (250 volt A.C.) is turned on, it holds the water in the bath at about 210 degs. F., with the expenditure of less than 1 k.w.

A.—Holes in cover of bath.
B.—Water tank.
C.—Heater filled with oil.
D.—Expansion funnel for oil.
E.—Leads to heater coils.
F.—Overflow pipe.
G.—Water supply cock.
H.—Supports for heater tank.
J.—End of iron wire spiral.
K.—Wood support for spiral.
L.—Water supply chamber.
M.—Supports for cover of bath.
N.—Water level.





Electric Heater for Steam Bath.

Correspondence

Discussion on Previous Articles—Readers' Queries and Comments. Remuneration for useful Ideas

REPLIES TO READERS' QUERIES.

In reply to H. Congdon's query in May issue of The Power House, I submit the following. It appears to me that what is wanted is a comparison of economy between two exactly similar engines carrying the same load, one with a higher pressure than the other.

Steam at 125 lbs.=1187 h.u. from water at 32 deg. F.

Steam at 100 lbs.=1182 h.u. from water at 32 deg. F.

The difference is so small that for all practical purposes it can be neglected in regard to extra fuel required, but the amount of work obtained from the use of the higher pressure is so marked that if the boilers will stand the increased pressure, it would be wasteful engineering not to take advantage of the increased economy obtainable. An example will show the relations between the two.

At 100 lbs. we cut off at half stroke.

At 125 lbs. we cut off at 5-16 stroke and obtain the same power.

For convenience in calculation we shall reckon our cylinder to have a capacity of two cubic feet.

As stated above, 3-16 of a cubic foot per stroke is saved. $\frac{400\times3}{16}$=75 cu. ft. steam per min.

Now, as was shown above, it took practically the same heat to evaporate steam at 100 lbs. as at 125 lbs. pressure, One cu. ft. of steam at 100 lbs.=3.8 cu. ft., therefore, 75÷3.8=practically 20 lbs.

20 lbs. × 60 minutes=1200 lbs. per hour, being excess of that required for 125 lbs. As one lb. of coal will evaporate approx. 8 lbs. water

$\frac{1200}{8}$=150 lbs. fuel per hour.

It is hardly necessary to point out that I have assumed a capacity of cylinder very much in excess of above examples. However, I have done so to avoid confusion amongst the younger generation of engineers.—H. Prew, Montreal.

In reply to H. Moore's queries in May issue of The Power House, I beg to submit the following replies:

A—1—Steam at 195 lbs.=379.6 deg. F. The total h.u. required from 32 deg. F.=1197. (1197+32)—80=1149. Theoretically, the equivalent will be 15,000÷1149, taking water as given at 80 deg. F.=13.05 lbs. steam. Of course, it is understood that it would be impossible to obtain this in practice.

A—2—Heat units from 32 deg. F.=1167, and as one h.u. is equal to one deg. rise in temperature, for one pound of water we have (1167+32)—100=1099. As one h.u. is equal to 778 foot pounds, therefore, 1099×778=855,022 foot lbs. Heat required to overcome internal R., 839.7; heat required to overcome external R., 77.7; sensible heat, 250.2. The three added together gives the total heat from 32 deg. F. as above=1167 h.u.

A—3—112 oz.=7 lbs. water at 45 deg. Fahr.

7 lbs.×13=h.u. from 32=91.

20 lbs. water at 160 deg. F.

20 lbs.×128 h.u from 32=2560.

4 lbs. ice at 32 deg. F.

It requires 142 h.u. per lb. ice to melt it to 32 deg. F., therefore, 4×142=568 h.u required. 2560+91=2651, of which we require 568 h.u., therefore, 2651—568=2083 h.u. are necessary to put into the water at 32 deg. F.

7+20+4=31 lbs. water at 32 deg. F.

$\frac{2083}{31}$=67.2, and as we had all the water at 32 deg. F., our temperature would be 67.2+32=99 deg. F. total.—H. Prew, Montreal.

HOLD-OVER MATTER.

We have been reluctantly compelled to hold over "Replies to Readers' Queries," "Boiler Design Discussion," further "Reader's Queries," etc., to a future issue, on account of pressure on our editorial space. The more urgent queries will be answered by mail.—Editor.

READERS' QUERIES.

British Columbian asks:—"What is the rule for finding proper size feed pump for a certain sized boiler or engine; say for instance a 950 h.p. engine using 25 pounds of steam per horse power per hour?

Western Engineer writes:—It recently became necessary to move some heavy machinery, and the question arose,—were the ropes in the block strong enough for the purpose? Pocket books were of course consulted, then other questions arose. Did the becket rope get more load than the others? How was the load distributed, and if not evenly, in what proportions on the various ropes? Argument raged and waxed hot all day, some holding that the load was evenly distributed, others that as the becket rope was not in motion, it therefore took the whole weight. It was even argued that with an evenly distributed load and given a sufficient number of pulleys to the sheaf, a ½-inch rope would lift anything. The text books did not say so. The even distribution man took on the job and accomplished it without accident, and claims the victory. I still have my doubts, therefore will some better informed reader give me the correct solution with explanation.

* * *

J. O. Graham, Orillia, wants to know the best method of determining the amount of steam that will flow through a given size opening at 100 pounds gauge pressure in a given time, also the rule for determining the heating surface of a dry kiln to maintain a temperature of 180 degrees Fah., when using steam at 2 pounds gauge pressure. No fan is to be installed with the kiln, the coils being at one end and the hot air circulating to a flue at the other.

W. H. Rennie, Kilmaurs, asks if there is any rule or method in setting Stephenson's Link Motion.

CHEAP POWER IN TORONTO.

As a power user you are interested in its actual cost to you, and have probably been waiting anxiously for many months to know what rates were to be charged by the city for Hydro-Electric power. These are now published and are, we venture to suggest, somewhat disappointing, although it is promised that as the number of consumers increases the charges will be lowered. This remains to be seen, and we may be excused; in view of the cost of upkeep, etc., on a long extra high tension system; if we doubt this possibility, unless of course current is to be sold at a loss, which must mean direct or indirect taxation, as someone will naturally have to pay for it.

Compared with charges for current in pre-Hydro days, the rates look attractive; but there is one very serious provision which experience shows us is frequently overlooked by the consumer; viz. the maxium demand basis.

It is common knowledge that with the exception of flour mills, and a very few other industries, the average load on a power plant is much less than the maximum—in fact in many cases the average load does not exceed one-third of the maximum. Under these circumstances it is evident that a consumer who is charged for current on a maximum demand basis is a serious loser, as he is paying for something he never gets; which is not a business proposition, and is a matter requiring the careful consideration of all manufacturers.

Taking the figures published in The Toronto "Telegram" of the 5th of May (vide page 19), referring to a manufacturer who is "connected to the mains for 100 h.p. with an actual maximum of 80 h.p.," and allowing; (as is insinuated in the case) that he really uses the 80 h.p. all the time his plant is running (see previous remarks on subject) we find his current costs him 1¼ cents per k.w. hour. This is of course for current alone, and does not include interest and depreciation on the necessary electrical equipment (for which of course the consumer has to pay) nor for wages of attendant, oil, repair and maintenance, stores, etc.

Now this power can be obtained in a small private installation for one cent per k.w. hour including everything; a reduction of 20 per cent. on the figures given which are evidently for an exceptional case and are not fairly representative.

"Fuel" oil can be bought in Toronto and many other towns in Canada for from 3 to 4 cents a gallon delivered in bulk, and by the use of this or other equally cheap oil in the Diesel engine the lowest possible costs for power are obtainable in small independent plants.

The first Diesel engine in Canada started running at Yorkton, Saskatchewan, on the 4th inst., being a 150 B.h.p. engine driving a dynamo for lighting purposes and will shortly be followed by two of 200 B.h.p. for operating the Moose Jaw Electric Railways—note the spirit of the West where suitable fuel oil cost 10 cents a gallon; which however only proves the truth of what we say about Diesel economy.

It is of course too early to give you operating figures from the Yorkton engines; and they would not be any criterion; as oil costs so much less in Toronto; but the following figures (from the actual logbooks) obtained in the power house of the English Daimler Motor Co., where oil costs over 10 cents a gallon may interest you.

Cost of Current in Cents per K.W. Hour on the Switchboard.

(Daimler Motor Co.)

Fuel	0.48
Wages	0.18
Lubricating oil, waste, water, stores, etc...	0.04
Repairs and maintenance...	8.05
Interest and depreciation @ 15 p.c.	0.25
Total operating costs	1.00

These works can be taken as fairly representative, the nature of the load can be judged from the industry concerned, and it will be seen that including 15 per cent. on capital outlay all wages, oil, repairs, stores, etc., (which please note are not included in the costs referred to in the "Telegram") the total operating costs are one cent per k.w. hour on the switchboard. Fuel oil costs only about one-third the price in Toronto, but labor is of course dearer here and allowing that they balance each other (which is far from the fact and is in favor of the Canadian user) it will be seen that it is possible to produce one's own power at a lower rate than that at which it can at present be purchased from the Hydro-Electric Commission even when granting them a 100 per cent. load factor, a very unusual condition.

We have been led to addressing you thus lengthily by the grossly misleading and oft repeated misstatements eminating from certain biased newspapers, and shall be only too pleased to give you further information, or to refer you to many works where results even surpassing those quoted are attained in year in and year out running.

Trusting that we shall be favored by readers' views on this most interesting and important subject,

THE CANADIAN BOVING CO., LTD.
F. A. YERBURY,
Vice-Pres. & Man. Dir.

Personal and Societies

The annual convention of the Canadian Society of Stationary Engineers to be held at Stratford, Ont., in July, will, it is expected equal and surpass in its numbers, work and results, those of previous years. Up to the present over 40 delegates have signified their intention of being present. The general secretary of the association, W. A. Crockett, has been in communication with the Premier, Sir James Whitney, regarding the resolutions of last November, on the subject of graded certificates, and hopes are entertained that he may accede to the association's request.

* * *

London Lodge, No. 30, Canadian Association of Stationary Engineers, held an open meeting in their club room, 211 Dundas Street. There were a number of short addresses from Bros Moll, Stephenson, Middleton and Barnes, after which refreshments were served, including ice cream and cake. Bro. Vincent, of Blyth, gave a good account of his work in Blyth. The musical part of the programme was furnished by the members. The annual picnic is to be held at Springbank on June 24.

TRADE NOTES.

The Toronto office of the Garlock Packing Co., of which Mr. Howard Fletcher is manager, has moved into new quarters at 77 Adelaide Street, W.

The Jones Underfeed Stoker Co., Montreal, recently closed an order for the installation of fourteen of their stokers in the big power plant of the Dominion Sugar Company, Berlin Ont. They are also at present installing stokers in the water-works and electric light plant at Brockville, Ont., and in the C.P.R. shops at West Toronto.

The Canada Foundry Company of Toronto, are installing a couple of Mather & Platt pumps for the Corporation of Farnham, Que.

The Escher, Wyss Co., Zurich, Switzerland, Canadian head office, Lumsden Building, Toronto, has recently secured the order from the town of Magog, Que., for two water turbines of the double Francis type, designed for developing 850 h.p. under a head of 20 feet, and running at a speed of 150 r.p.m. They have also secured the order for two oil pressure governors of the Escher, Wyss Co. design, for connection to the above turbines.

AN EFFICIENT POWER PLANT.

The lighting and water power plant of the municipality of Kincardine, Ont., recently came under the notice of one of our representatives, and what he saw there we are pleased to give publicity to, believing that it will serve to encourage many other operating engineers in their efforts to not only keep the wheels going up to their highest pitch of efficiency, but at the same time induce more inclination in the direction of clean and tidy house-keeping, as applicable to engine and boiler-rooms..

The plant is owned by the municipality and controlled by a commission, to whom the engineer is responsible for its efficient and economical operation. As a result of success in the latter direction, cheap light and water rates are enjoyed by the town's people. Our representative gives forceful expression to the conditions prevailing at the power house by saying that one on entering is constrained to look at his shoes to make sure that they are clean enough to go inside.

A. H. Ingram, engineer-in-charge, is, needless to remark, a reader of "The Power House," and expresses his views of its worth by saying, that in spite of his experience and knowledge, every issue brings new and helpful ideas and information to him.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

TURBINE PUMP RECORDS.

The performance of the engine driven turbine pump at the Low Level Station of the Montreal Water Works is worthy the attention of water works and hydraulic engineers, because hitherto it was considered impossible to deliver water with commercial success against high heads by this means. The plant consists of a Three-stage Turbine Pump built by the John McDougall Caledonian Iron Works Co., Montreal, and a Bellis and Morcom 750-h.p. triple expansion steam engine, supplied through their Canadian agents, Laurie & Lamb, Montreal. The contract provided that the unit should have a duty of 100,000,000 foot pounds for each 1,000 lbs. of steam at 100 deg. superheat, allowance being made for all heat returned to the boilers.

An official test, details of which are given, was conducted by Mr. R. J. Durley, Professor of Civil Engineering at McGill University, who found that the duty of the pump and engine was equivalent to 110,151,000 foot pounds per 1,000 lbs. of steam superheated 100 deg. No indicator cards were taken officially, they had no bearing on the contract; but they were taken unofficially by the representative of the engine builder. The indicated horse-power on these cards showed that the total overall efficiency was 70 per cent. This included not only pump losses and engine losses, but the power required to drive the air and feed pumps, which were attached to the main engine and for which no allowance had been made. Although the duty obtained does not compare favorably with the best practice in high duty pumping engines, the contract price of the plant was only one-third of the price asked for vertical triple expansion pumping engines of equal capacity. Considered as a commercial proposition, it will be found that the interest on this difference added to the difference in the cost of engine house and foundations will more than make up for the extra fuel consumption.

Test Particulars.

As already stated, the contract provided that the pump and engine should have a duty of 100,000,000 foot lbs. for each 1,000 lbs. of steam at 100 deg superheat. It further provided for a forfeit of $2,000 for each 1,000,000 foot lbs. below the stipulated duty, or a bonus of $2,000 for each 1,000,000 foot lbs. above the stipulated duty; but this bonus was limited to a duty of 105,000,000 foot lbs. In consequence of the results shown by these different tests, the city paid a bonus of $10,000 to the pump builders.

The average steam consumption per pump H.P. per hour was 18.82 pounds with an average superheat of 120 deg. As the contract called for 100 degrees superheat only, it was necessary in order to arrive at definite figures to represent the latter, to plot a diagram, From this an increase of 3 per cent. or in amount 19.50 pounds per pump H.P. was arrived at.

Pump Performance.

Duration of test, 13 hours.

Total water pumped during test, 6,515,000 Imp. gals.

Average water delivered per hour, 501,155 Imp. gals.

Rate of pumping per 24 hours, 12,027,700 Imp. gals.

Total average corrected head, 204.98 feet.

Average work done on water per hour, 102,726,752 ft. lbs.

Steam Consumption.

Average corrected steam pressure gauge, 142.72 sq. in.

Barometric pressure, 14.69 lbs. sq. in.

Average actual steam temperature at engine, 481.9 deg. Fah.

Average superheat of steam at engine, 119.6 deg Fah.

Total steam condensed during test, 125,644 lbs.

Average steam condensed per hour, 9,665 lbs.

Excess superheat over that specified, 19.6 deg. Fah.

Steam consumption per hour corrected to 100 degrees superheat, 9,955 lbs.

Feed Water and Heat Returned to Boiler.

Temperature of water supply, 42.0 deg. Fah.

Average temperature of feed water leaving heater, 98.8 deg. Fah.

Total water supplied to boilers (corrected), 2,879 cu. ft.

Average water supplied per hour, 221,46 cu. ft.

Average weight supplied to boilers per hour, 13,737 lbs.

Heat returned to boilers per hour, 780,261 B.T.U.

High Level Station.

The unit in the high level station on McTavish Street consists of a three stage turbine pump, built also by the John McDougall Caledonian Iron Works Co., driven by a 400 H.P. motor built by Allis-Chalmers-Bullock, Montreal, and operating under full load at 620 R.P.M. on a 3-phase, 60-cycle, 2,200 volt current. The pump contains several novel features to eliminate noise and vibration and a special thrust bearing which is stated by the superintendent of the water department, to be operating satisfactorily. L. A. Herdt, professor of elec-

Turbine pump in high level station, Montreal Waterworks.

It's All Well Enough

¶ To get out special steam boiler numbers—indeed the steam boiler builders, and the steam engine builders, too—have got to do something to save their feathers, but the fact remains that with the very best steam plant that can be built to-day, about ninety cents out of every dollar's worth of coal burned under the steam boiler goes to waste.

¶ Why put in such a plant?

¶ Would you put equipment in any of your other departments which could show an efficiency of only ***Ten per cent.?*** Certainly not.

¶ Our gas engine plants will produce power at from one-third to one-half the costs of the best steam plant, and we can show something like sixteen plants which are more than proving it.

¶ If you are thinking of buying a steam equipment, all we ask is a chance to show you what a mistake you would make to buy it.

Colonial Engineering Co., Limited

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It has been proved that **one-eighth** of an inch of scale means a fifth decrease in efficiency, and a quarter more coal consumption than is necessary to give the required steam.

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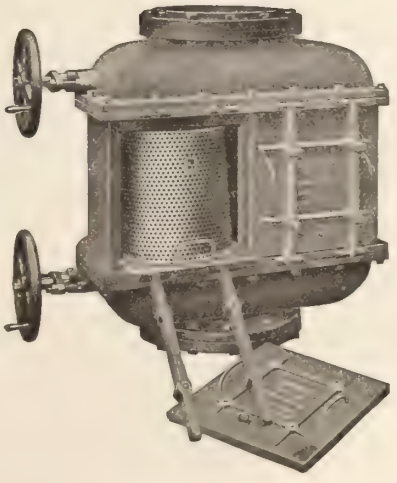

Ever noticed the foreign matter in your Feed Water?

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Elliott Company

6902 Susquehanna Street
Pittsburg, Pa.

trical engineering at McGill University, conducted the test for acceptance on behalf of the city of Montreal.

Test Results Obtained.

The discharging capacity of the pump was guaranteed to be five million Imperial gallons per 24 hours pumped against a pressure of 110 lbs. per square inch.

The water pumped during the first twelve (12) hours amounted to 2,725,000 gallons, against an average pressure of 107.2 lbs. per sq. inch ; during the second twelve hours, 2,745,000 gallons, against an average pressure of 106.3 lbs., or a total of 5,470,000 Imperial gallons for the 24 hours.

The average electric horse power consumed during the test, for the first twelve hours was 421 H.P., and 421.3 H.P. for the second twelve hours.

The maximum power used was 138.5 H.P. The pump was then pumping at the rate of 4,080 gallons per minute, that is, over 5.8 million gallons per 24 hours.

The overall efficiency of the pump is as follows :—

When pumping 3,500 gallons per minute, 65.00 per cent. average.

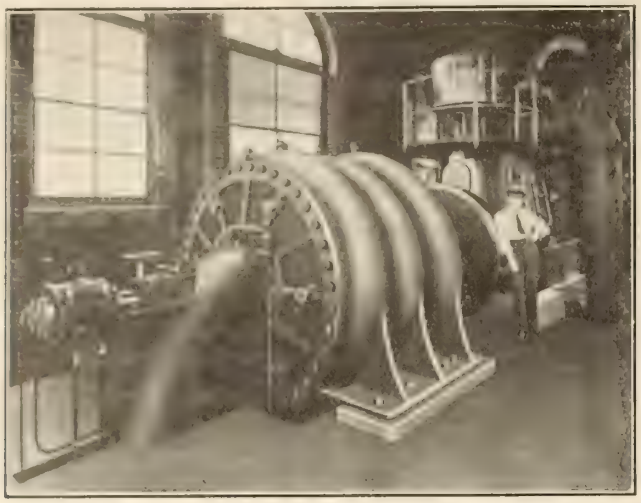
When pumping 3,700 gallons per minute, 66.05 per cent. average.

When pumping 4,000 gallons per minute, 67.00 per cent. average.

The pump was guaranteed to show an overall efficiency of not less than 65.0 per cent.

The rise of temperature of the electric motor above that of the surrounding air did not exceed thirty degrees centigrade ; this comes well within the specifications, as a rise of 40 degrees was allowed at full load.

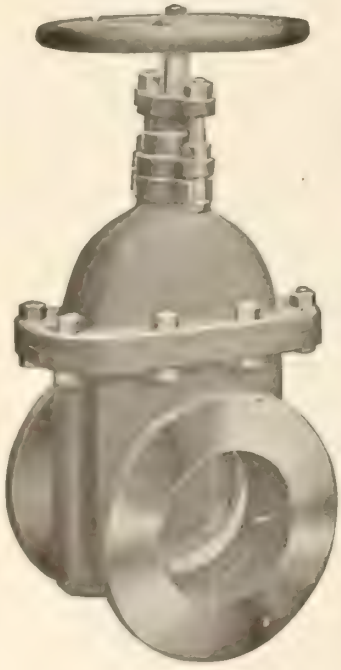
A noticeable feature shown during the test, was an increase in efficiency from 65 per cent., when running at its rated capacity of 5,000,000 gallons, to nearly 69 per cent. when running above its rating ; in other words, when pumping at its most economical capacity it showed an efficiency of nearly 69 per cent.



Turbine pump in low level station, Montreal

Personality of Design.

The pumps described, were built from the designs and under the supervision of Mr. W. Clinton Brown, formerly chief engineer for Henry R. Worthington, New York, and now consulting engineer for the John McDougall Caledonian Ironworks Co. It speaks volumes for his and their success in the turbine pump field, that not only have further orders from the city of Montreal for larger and motor-driven units been received, but it is worthy of note that probably 80 per cent. of the turbine pumps built and operating in Canada, are of their design and manufacture.



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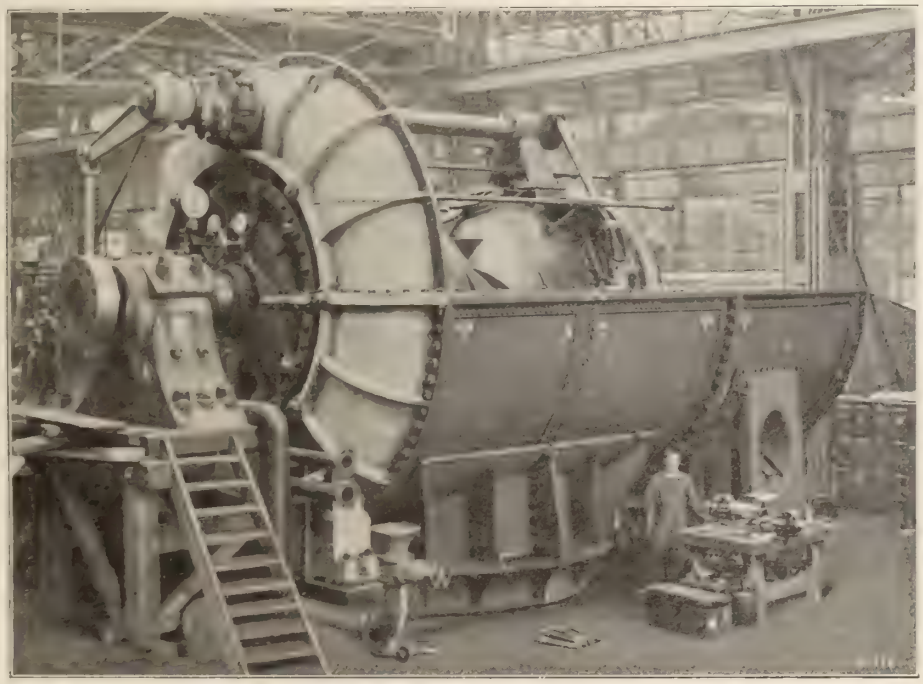

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POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

COMOX—Tenders addressed to W. L. Coulson, general manager, will be received until June 26th for supply of hydro-electric equipment for the Canadian Collieries (Dunsmuir), Ltd., Puntledge river. Contract includes complete hydraulic and electric equipment, furnishing and instalation of two direct-connected units, each unit developing 3,750 k.v.a. at switchboard. Plans at office of company, Pemberton Block, Victoria.

PRINCE RUPERT—A party of Montreal capitalists has secured control of the largest water power in the Prince Rupert district. The local interests are headed by Mr. Charles H. Cahan, K.C., president of the Western Canada Power Company, Ltd., and Mr. H. A. Lovett, K.C., who during the past year has been identified with some of the largest financial deals that have been carried through in Canada. It is their intention to form the Prince Rupert Hydro-Electric Co., Ltd. The Prince Rupert Hydro-Electric Co. has acquired the control of the Tsimpsean Light & Power Co., and of the Continental Power Co., Ltd., and the water rights on the Khtada and Fells rivers, branches of the Skeena river, which were formerly controlled by these two companies. These water powers, which are located about forty-two miles from Prince Rupert, are capable of developing at least 25,000 to 30,000 horse-power of electric energy. It is the intention of the company to develop about 1,500 horse-power of electric energy, by means of a provisional power plant, to supply the immediate demands of the City of Prince Rupert, and to proceed to the construction of a permanent instalation capable of supplying 15,000 horse-power so soon as the Grand Trunk Pacific Railway is running [illegible] its Pacific teminus.

Alberta.

CALGARY—The Alberta Electric Railway, of Calgary, will commence work at once on a number of new lines and power houses. Several millions will be expended.

CARDSTON—Cardston will install a complete new waterworks pumping plant.

BLAIRMORE—Owing to the fast growing population and the consequent large increase of buildings in Blairmore, the present lighting and power plant is becoming inadequate to supply the demands, and it is found that some improvement must be effected in the near future if a satisfactory service is to be given the Town of Blairmore. It has always been the desire of the Rocky Mountain Cement Co. to satisfy its patrons, and knowing that the present electric light service, which they supply the town, is now perhaps not all that it might be, they have decided to do all possible to meet the requirements of the people of this town, and have already let the contract for additional electric lifting apparatus, consisting of 2,000-volt, 3-phase, 125 k.v.a. alternating current generator, exciter and all auxiliary connections for same. This machinery will cost several thousand dollars and will be installed immediately upon arrival. By this the plant will be considerably improved and the service is sure to be most satisfactory, giving us one of the best electric light and power plants in this district.

Saskatchewan.

ESTEVAN—Estevan will extend its waterworks pumping plant.

MOOSE JAW—Moose Jaw will buy $40,000 worth of new electric lighting machinery for extensions to its present plant.

PRINCE ALBERT—The City of Prince Albert is calling for tenders for the building of a big electrical power development plant on the North Saskatchewan river.

CANORA—By-laws aggregating $100,000 for waterworks and electric light, have passed the council, and will shortly be submitted for approval.

MOOSE JAW—Contracts for equipment for the power house were awarded as follows: To the Babcox-Wilcox Co., boilers at $5,975, stoker at $2,000, piping at $375, tee bars and supporting flue $200. The city weigh master reported receipts for the week of May 30 as follows: Water, $7.67; scales, $6.50; dog pound, $8.00.

WATROUS—Norman Baker Wilkes has returned from Winnipeg, having completed arrangements with the Brydges Engine & Supply Co. for the installing of an 82 horse-power gas engine, a 90 horse-power suction gas producer, and a 50 kilowatt generator for supplying electric light to the town. The plant will be erected opposite the round house, and will have an indefinite capacity which will grow with the town, but the present instalation is sufficient for a town of 3,000. The machinery is expected here by June 15, and if all goes well, will be in operation by October first.

Nova Scotia.

MIDDLETON—A by-law is under consideration to provide $15,000 for the purchase and installation of an electric light plant.

HALIFAX—Halifax will spend $100,000 for new waterworks equipment and machinery.

NICTAUX FALLS—E. M. Archibald, of Nictaux Falls, N.S., will build a power plant there, costing $100,000.

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You can buy a Boiler Composition that is absolutely reliable, effective, and economical.

It sells at a comparatively low price, but the great saving is in the fact that "**KELVIN**" **Boiler Composition** saves Boilers from deterioration.

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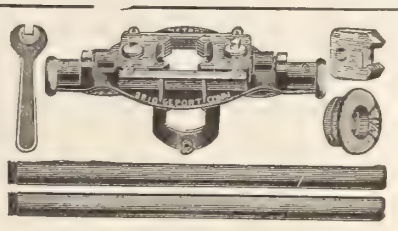

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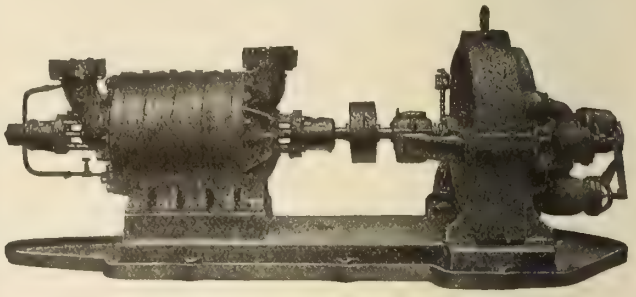

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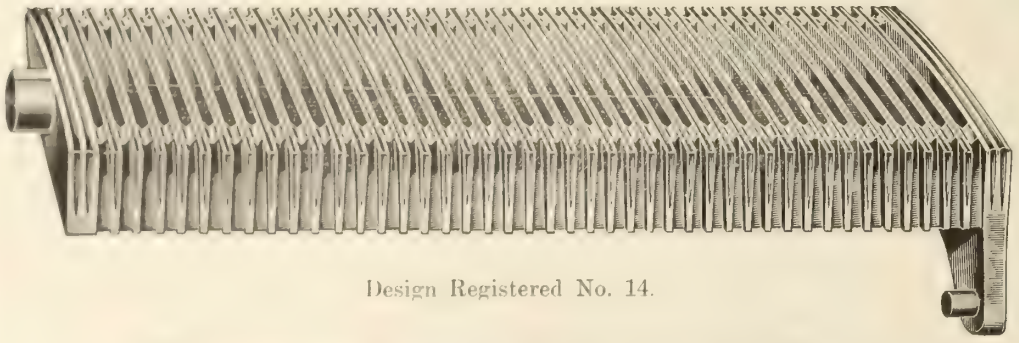

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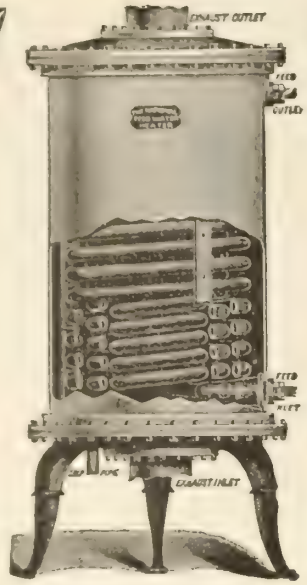

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The Feed Water Heater makes use of the heat in the exhaust to save fuel by heating the feed water to the boiling point before it reaches the boiler.

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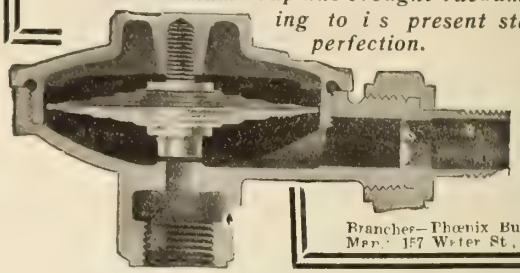

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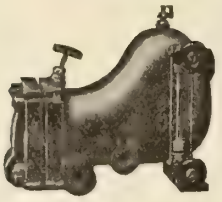

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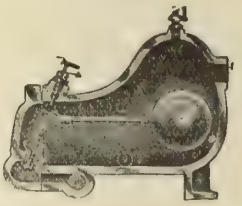

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The "P.H.B." Quick Closing Water Gauge has an extra heavy body and is perfect in structure.

It is made of the best Steam Metal with extra large nuts for heavy washers.

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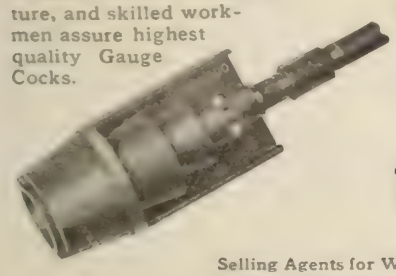
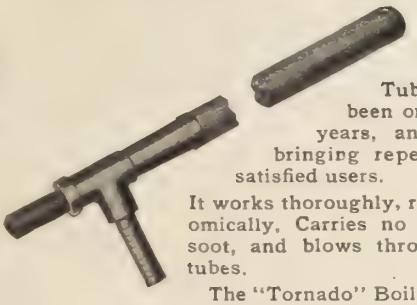
The best grade material only is used in their manufacture, and skilled workmen assure highest quality Gauge Cocks.





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It works thoroughly, rapidly and economically, Carries no moisture to wet soot, and blows through the longest tubes.

The "Tornado" Boiler tube cleaner is absolutely reliable and performs its work with the greatest possible ease.

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To Be Able to Test the Valve
In Your Steam Traps
Without Time or Trouble.

Trade Mark.
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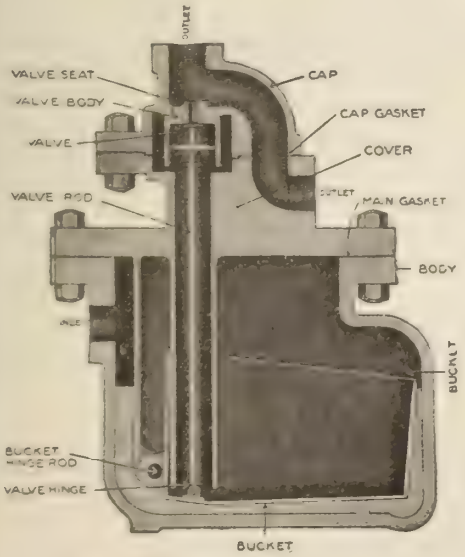

If the valves in your steam traps are leaking steam, and they probably are; if you have to take the time and trouble to take the trap apart to get at the valve, and the leak is 1/8 in. and your pressure 75 lbs., you are saying good-bye to at least 275 lbs. of coal every 9 hours. Why don't you buy

Strong Steam Traps

and know what is going on? Let us send you our catalog 14, explaining our valve testing without loss of time. Oh, yes! "On their merits alone we ask your patronage."

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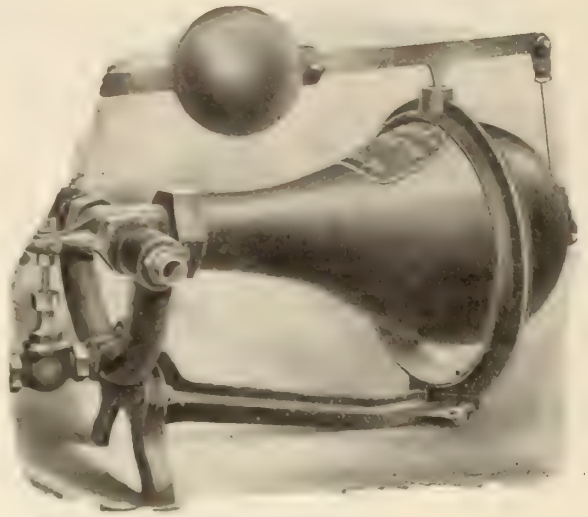

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BECAUSE Bundy Steam Traps mean Bundy Service.

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We are also ready to furnish expert service in connection with all questions relating to Heaters, Condensers (Steam and Ammonia), Shaking Grates, Special Engine and Ammonia Packings, and every form of pressure and temperature control.

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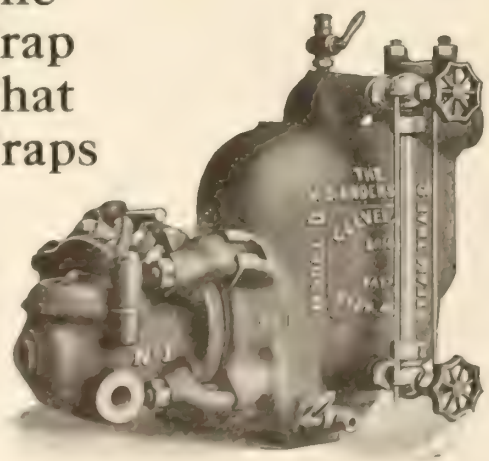
Discharges the Water AND Holds the Steam

The Trap That Traps



It is all that its name implies---a trap for steam from which steam **never** escapes, and water of condensation **invariably does.**

The body is constructed of close grained iron, with a valve which can be removed without disconnecting trap from pipes.

The valve and valve seat, of phosphor bronze, are simple in construction and easy of access.

The Anderson will deliver exhaust water against any back pressure of five pounds less than the steam pressure at the trap.

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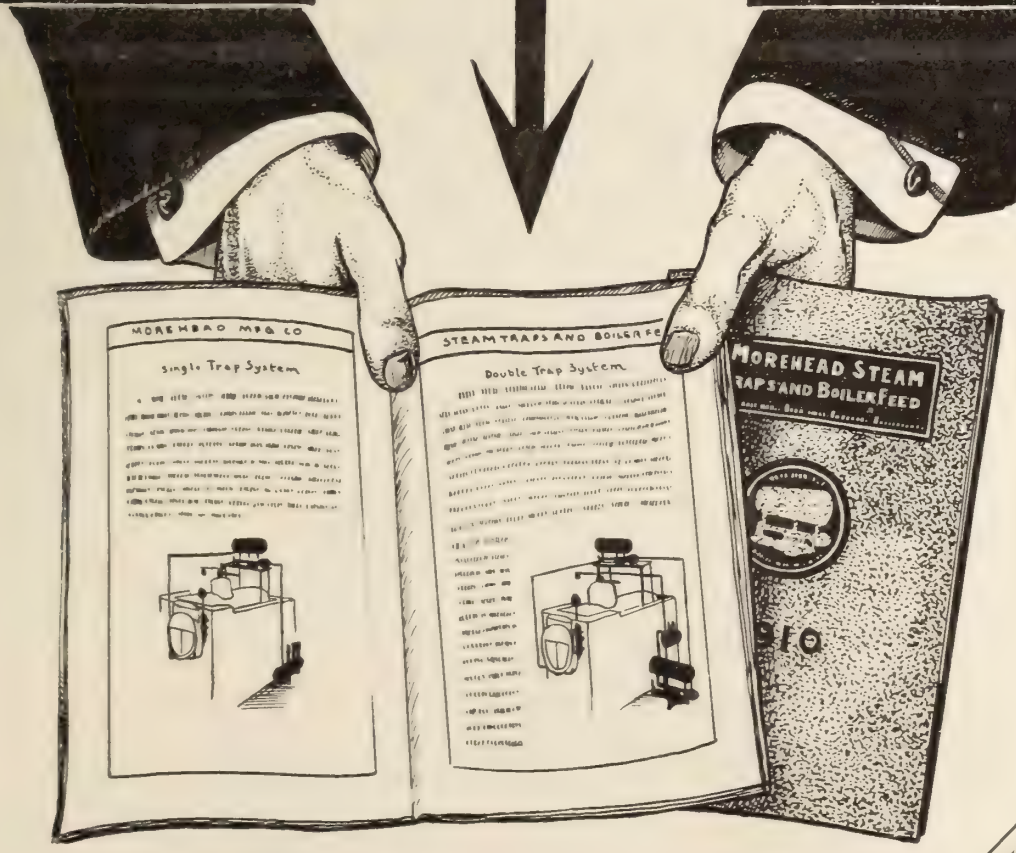

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"CAMEL" Brand Belting excels all other belting in ***strength.*** Its strength is greater than that of any double-leather belting.

Economy.—It will outwear any other belting.

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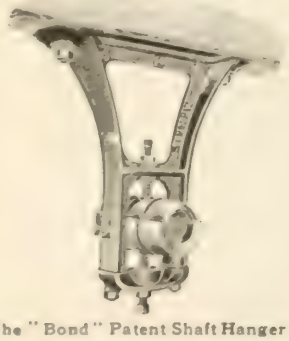
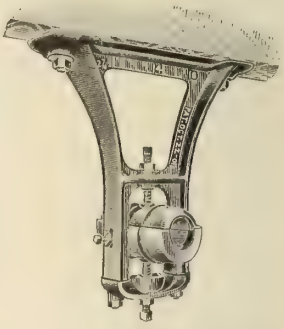


The "Bond" Patent Shaft Hanger



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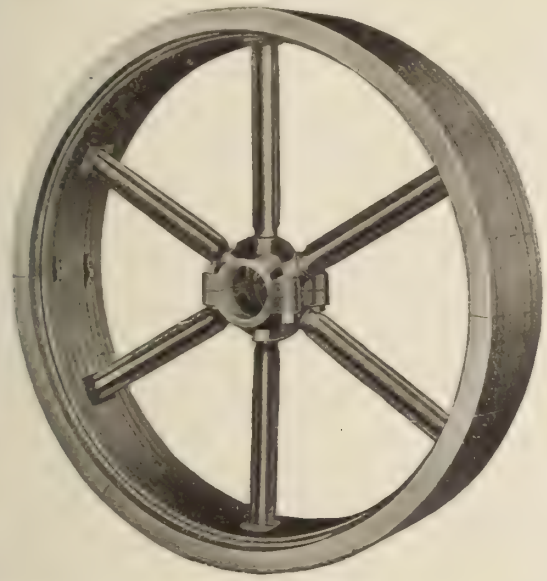

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Combines more good features than all other pulleys put together.
Will transmit more power and consume less power than any pulley made.

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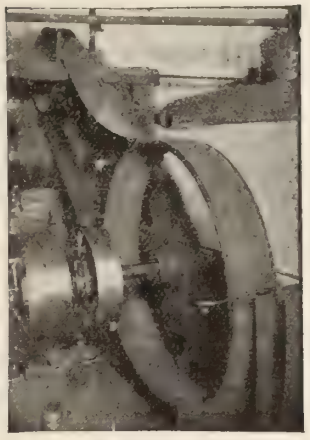
This man bought Cling-Surface in December. Read what he wrote in February



Cling-Surface demonstrates its worth quickly as proven in the following letter from Mr. James Jordan, Engineer, E. H. Taylor, Jr. & Sons' Distillery, Frankfort, Ky. Read what he says, for you can profit from his experience:

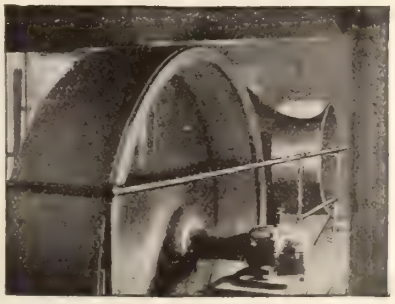
"After 22 years' use of belt dressings, I know that Cling-Surface is the only belt treatment. I used six kinds of dressing in five years, and the more I used the worse shape the belts got in.

"After overhauling the machinery, I started without anything on the belts. After a month I had to use something and tried Cling-Surface. **Now my belts are in good shape.**

"I will never be without Cling-Surface any more. Nothing but Cling-Surface for me and I surely will recommend it to all my friends."

Cling-Surface makes belts clean, pliable, healthy vigorous, water, oil and fume proof, able and ready to work. It penetrates into the body of the belt to preserve and lubricate the interior fibers and, as a result, also puts the belt surface into the best possible condition to conform to every little unevenness of the pulley surface. The belt face becomes soft and moist with a gripping and cohesive power like the live hide, while the greater flexibility of the interior aids in making the pulley contact perfect.

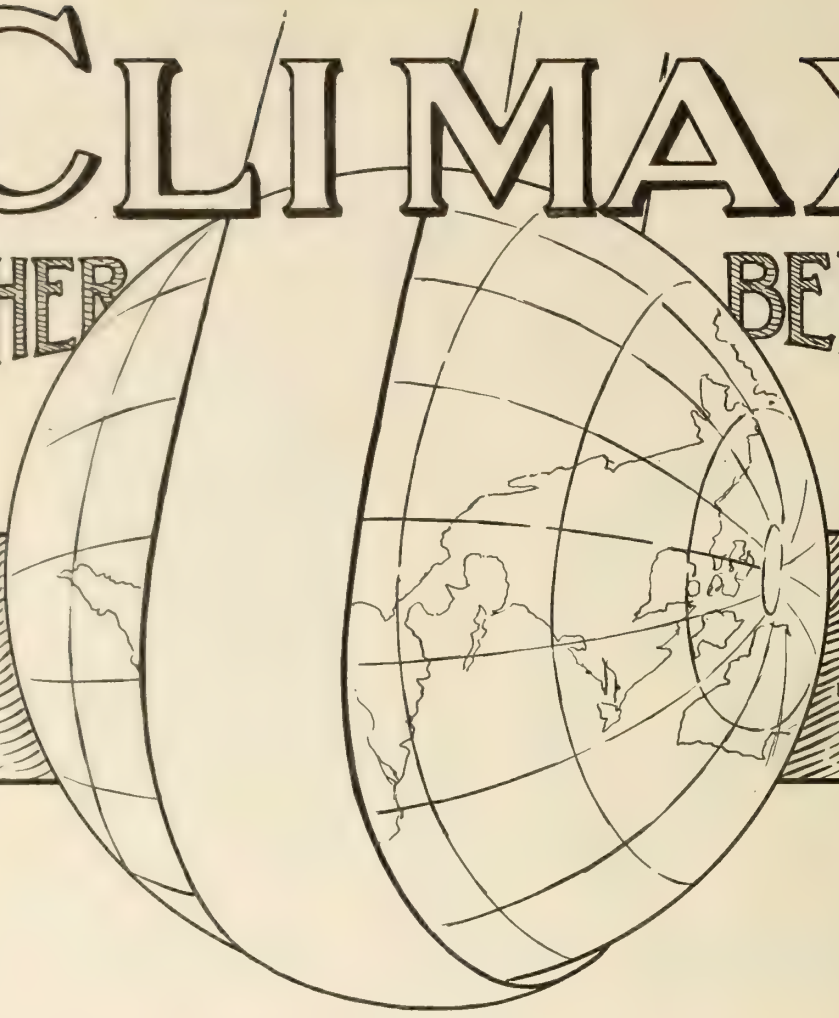
A belt properly treated with Cling-Surface never slips. It can be run easy or slack without annoyance, for the good effect of Cling-Surface is the same every day in the year.



One application will convince. Give us one small order or at least write for literature.

Cling-Surface Co
1057 Niagara Street - Buffalo N Y

CLIMAX LEATHER BELTING



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Extreme tests are the ones that prove the qualities of Belting.

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It is important to you to have the best grade of Belting only in your plant.

It eliminates danger of accidents and breakdowns, and through length of service proves to be far less costly than cheaper grades

"CLIMAX" Leather Belting has every quality you demand, including moderate price.

We can supply **"CLIMAX"** Belting in any one of the various grades as your needs may require, from stocks carried at our branches.

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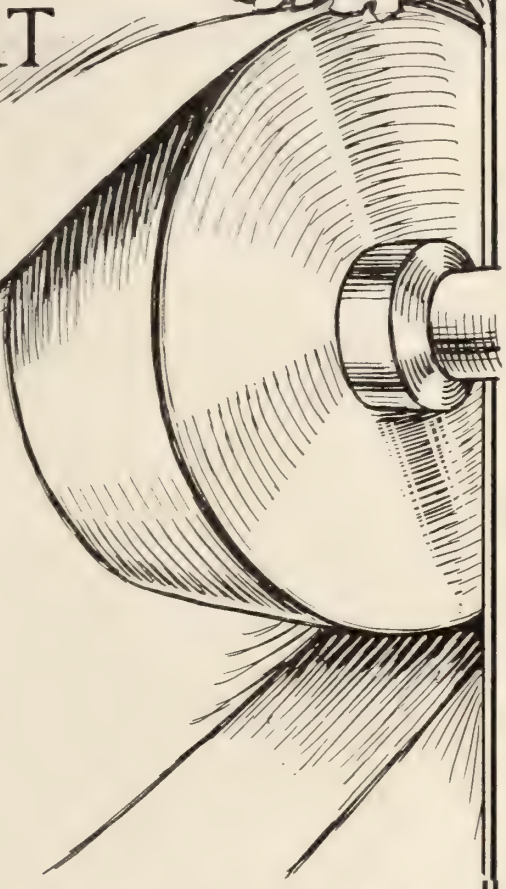

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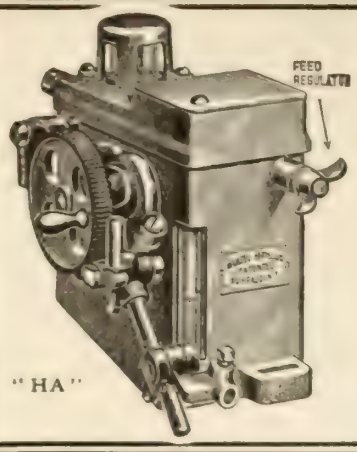

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Install a Manzel New Model Oil Pump, Class "HA."

Here are a few features:—
Supplies perfect lubrication.
Requires 30 to 60% less oil.
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Easily regulated to feed exactly the amount of oil needed—a drop every minute or a stream with every stroke.
Constant sight feed in plain view from all parts of engine.
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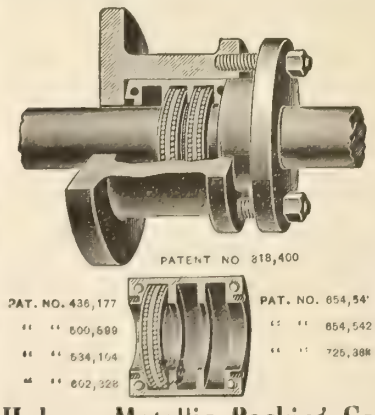

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We can give you this cup in buff finish or satin finish as you prefer. Do not hesitate to ask for prices or samples.

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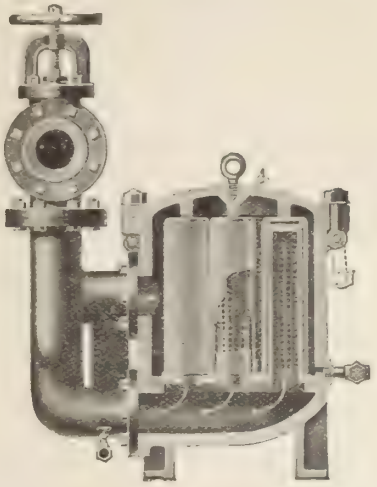

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This Blackburn-Smith Feed Water Filter and Grease Extractor met unusually severe requirements and demonstrated its actual worth from the first day of its installation.

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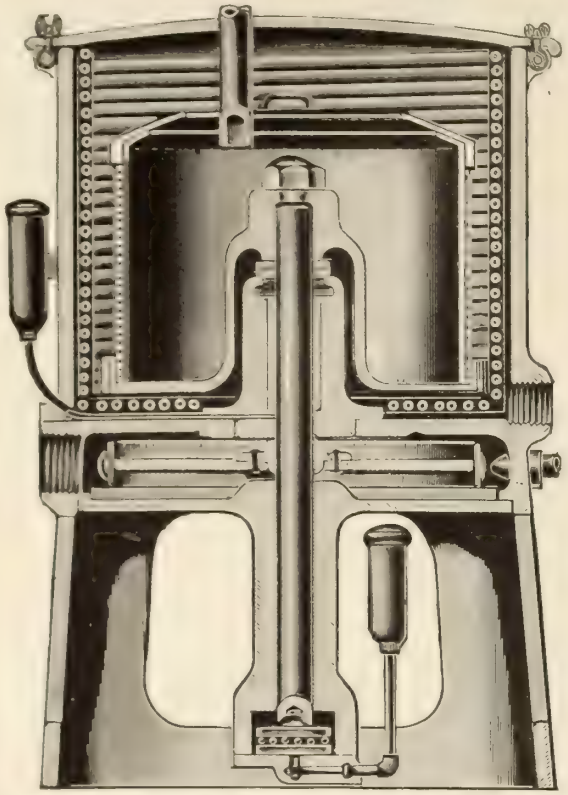

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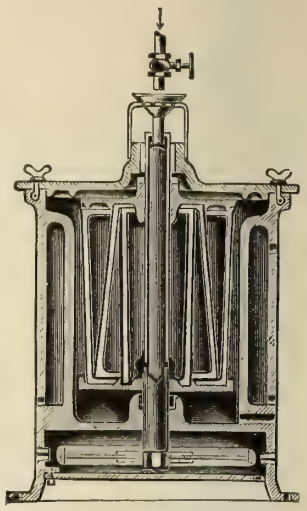

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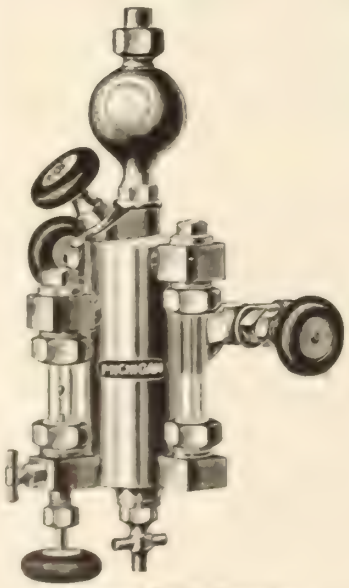

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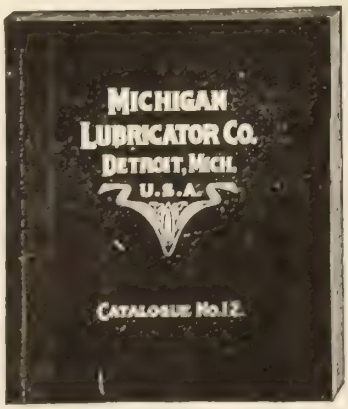

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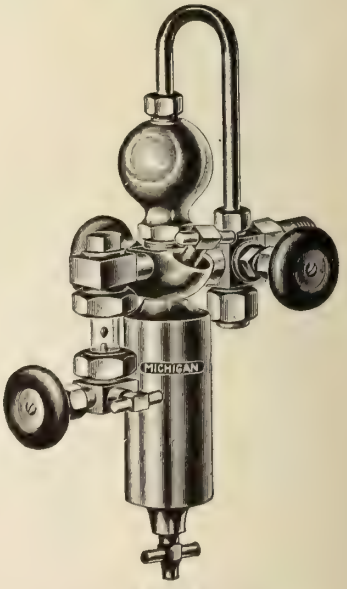

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We have the cup that will eliminate such losses and obtain the best results.

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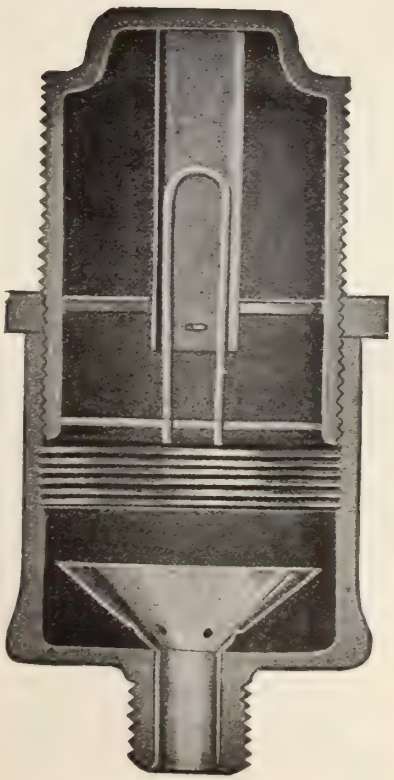

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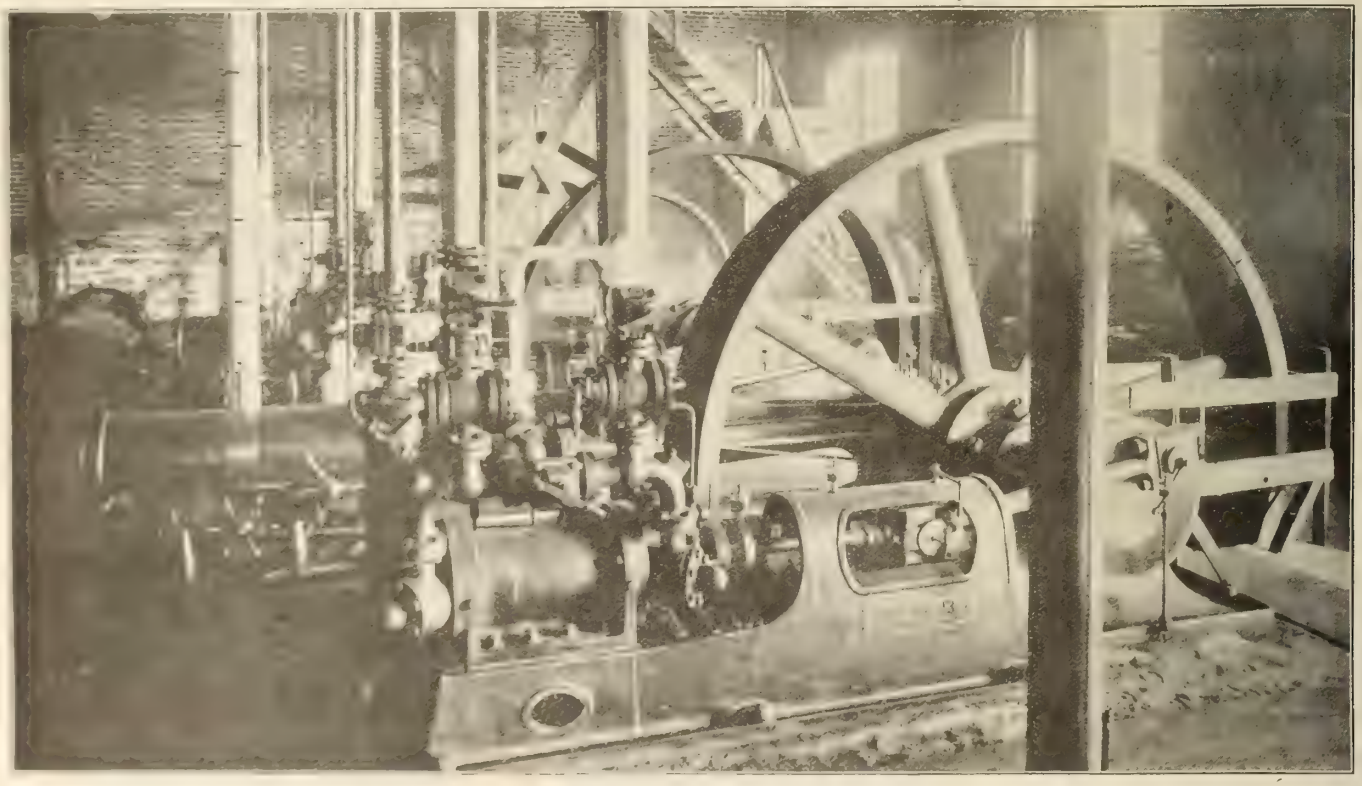

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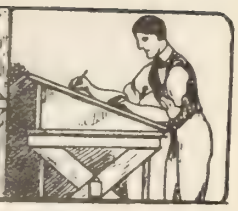

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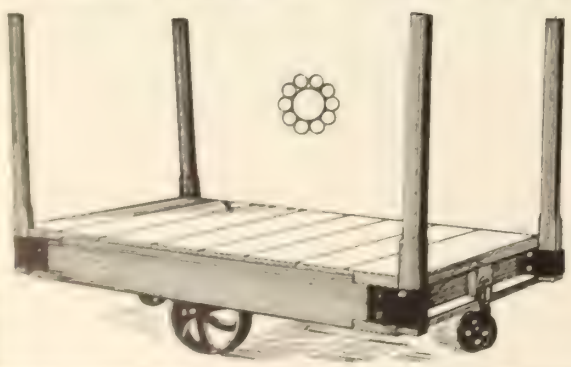

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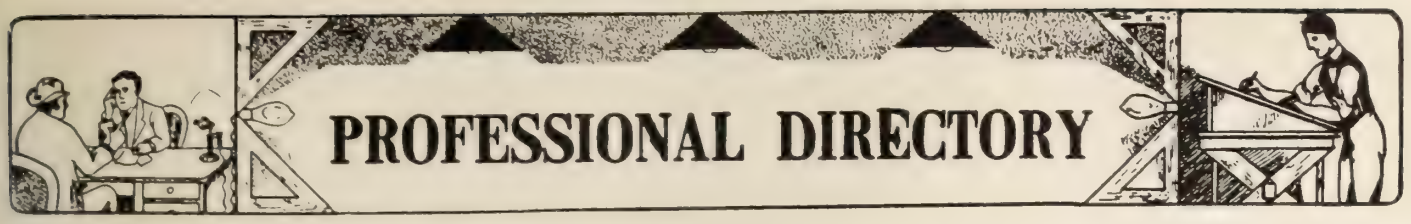

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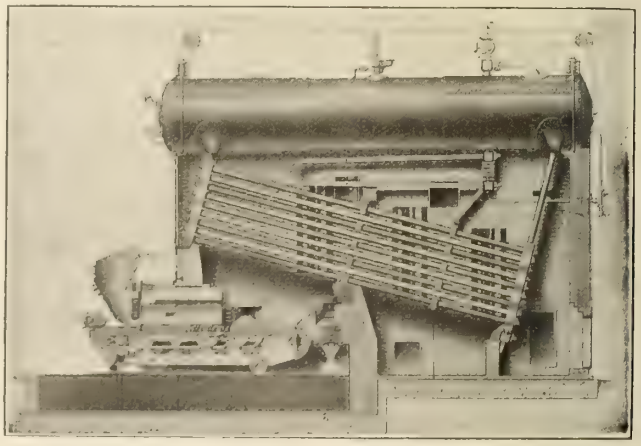

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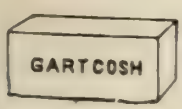

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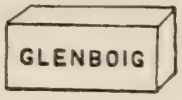

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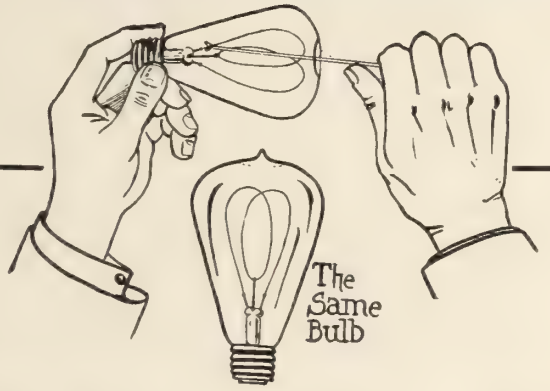

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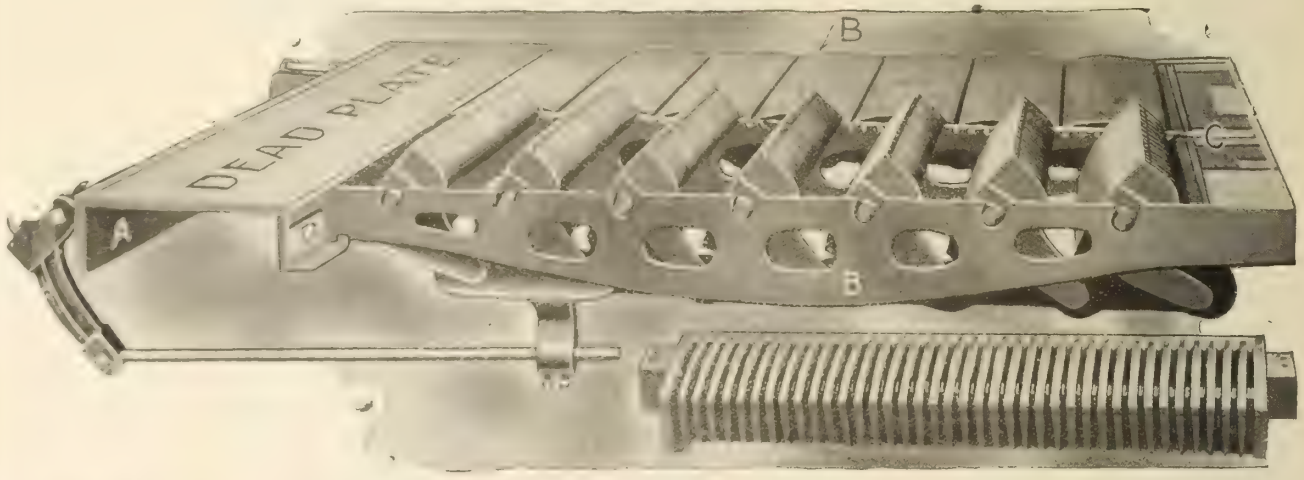

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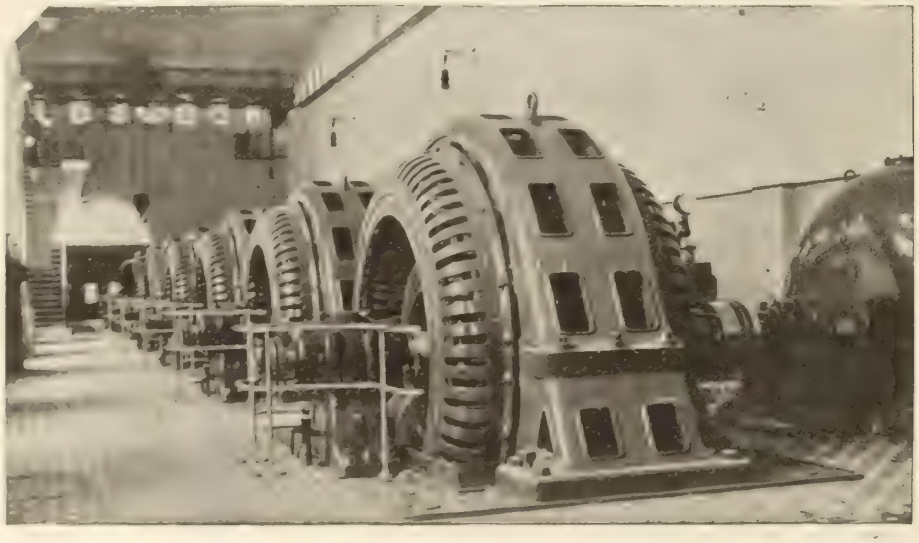

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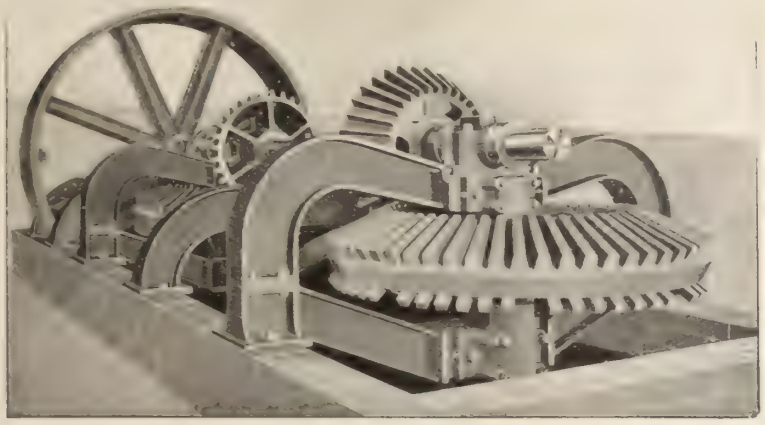

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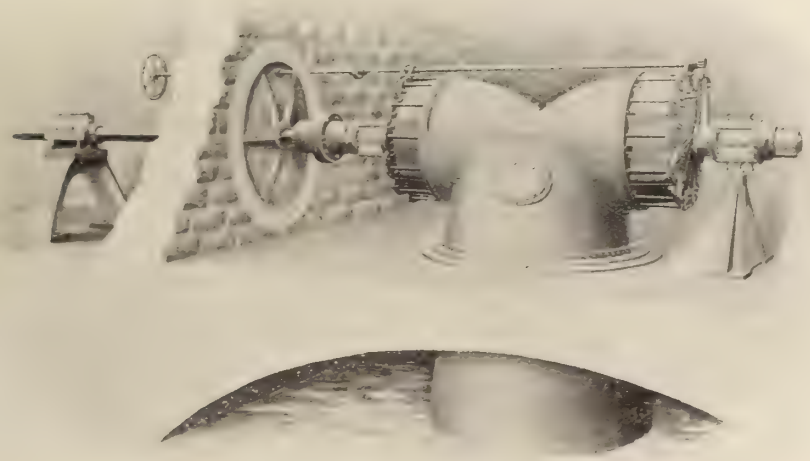

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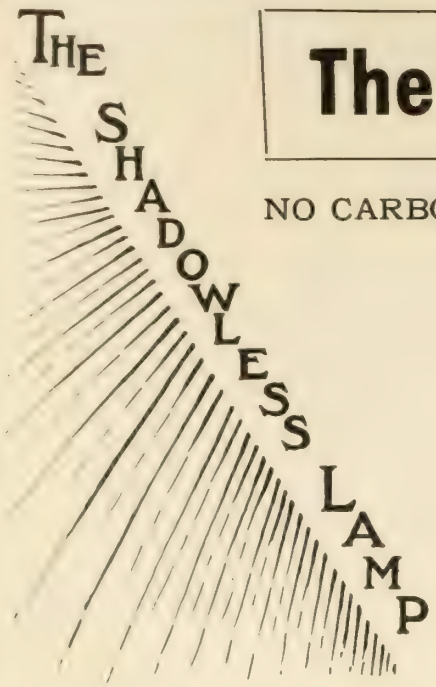

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These instruments are only 5 inches in diameter, and are intended for use where space is limited. Both Ammeters and Voltmeters are of the permanent-magnet, moving-coil type. The moving element may be removed without disturbing the permanent magnets. The scale subtends an arc of 120 degrees and is almost four inches long.

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Morrison's J.M.T. Injectors Morrison's Steam Gauges
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are an absolute insurance against trouble, being carefully constructed of the best metal and guaranteed for long service. We are specialists in every detail of brass manufacture and have a country wide reputation for reliability and satisfaction.

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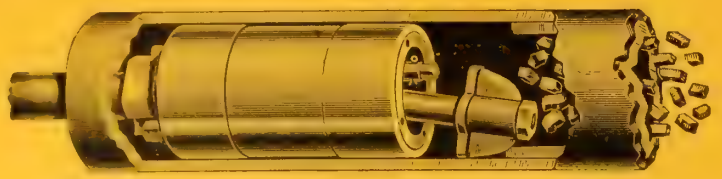
The Trend of New Thought

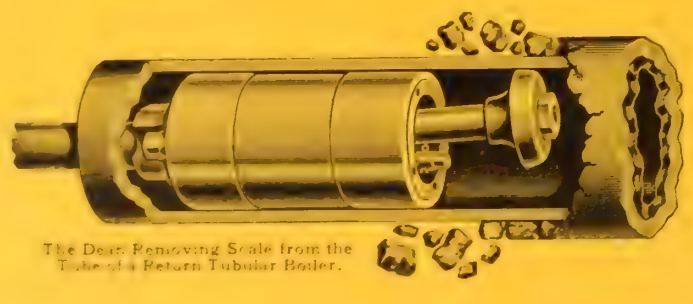


The Dean Removing Scale from the Tube of a Water Tube Boiler

The Dean is upsetting old theories about boiler cleaning. Everybody formerly had the compound habit. Faith in compounds was almost universal. 'Twasn't an opinion founded on facts, but a habit of the mind. Then the Dean came. Lots of engineers tried it, more out of curiosity than because of any faith in it. They discovered to their surprise that the Dean could get anywheres from 300 to 800 pounds of scale from a compound-cleaned boiler. They saw they could save coal for their employers and get better steaming from their boilers by its use. They learned that by periodical use of the Dean, they could keep their boilers clean—and they stopped paying tribute to the compound man. The trend of new thought is towards

THE DEAN BOILER TUBE CLEANER

It has won out not because of promises we made of what it would do, but because of results actually accomplished. We have never asked a man to buy promises. We have been selling results. We say to a man: Here's the Dean, try it in one of your boilers, and see what happens. And what happens? About 99 times out of a hundred the Dean sticks, and for no other reason than that it surprises and satisfies the man who tries it. The reason why you don't use a Dean is that you haven't tried it.



The Dean Removing Scale from the Tube of a Return Tubular Boiler.

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Try the Dean in one boiler. If you don't like it, return it at our expense. If you purchase we will guarantee the tool to pay for itself in six months.

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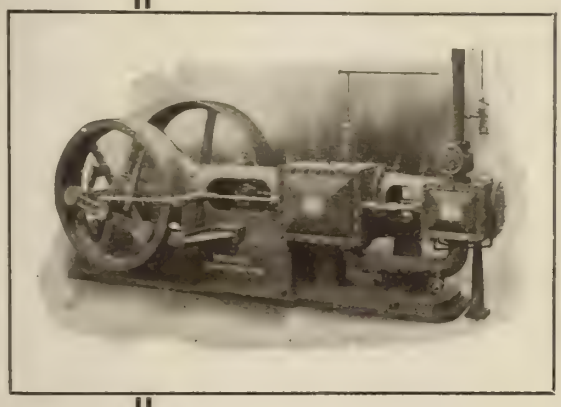

"The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution. Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar."

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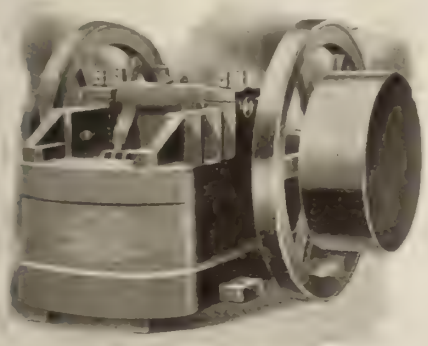

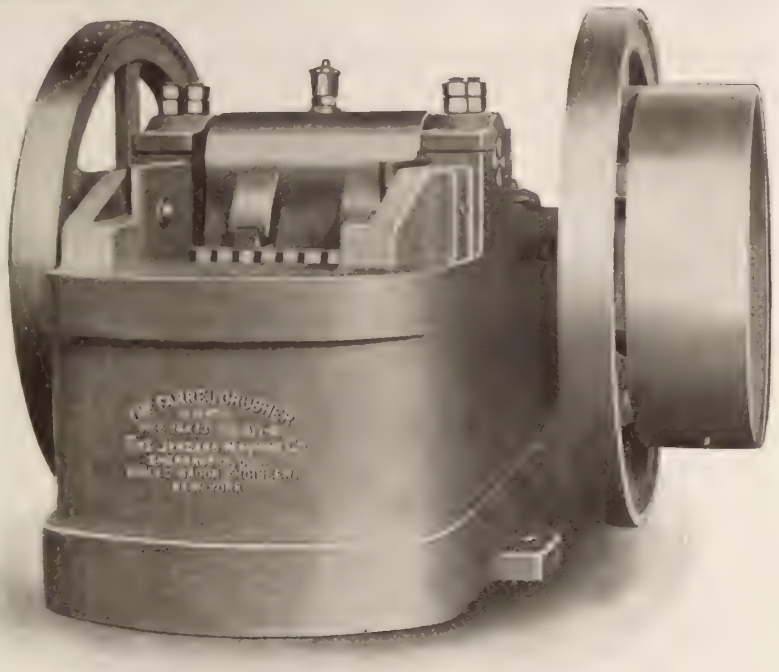

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and you'll get the right thing, if your idea of the "right thing" is a gasket that will make **positively and permanently tight joints** in flanged piping. And this means tight joints in spite of the **highest** of **pressures** or **temperatures**—even **highly superheated** or **saturated** steam and in **long lines.**

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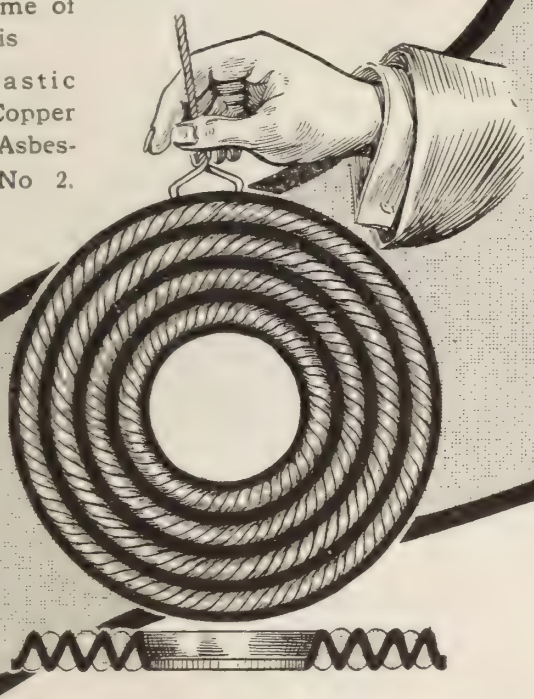

We'll send you a supply of Goetze's No. 2 Gaskets on 90 days' trial at OUR risk.

But you don't have to say, or write, all that in ordering. Save your time by writing simply "Goetze's No. 2 Gaskets" and you will get what you want and get it promptly. Simply give us the sizes you want, and the number of each size, and unless you specify something "special," we will ship them within **30 minutes** on receipt of your order.

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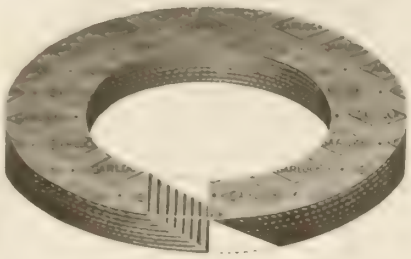

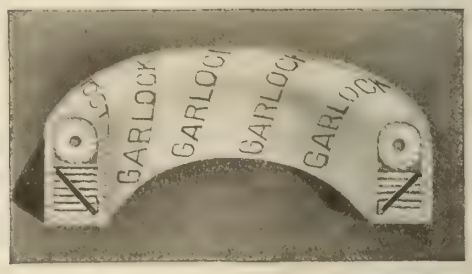

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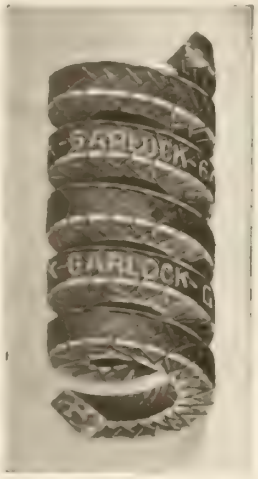

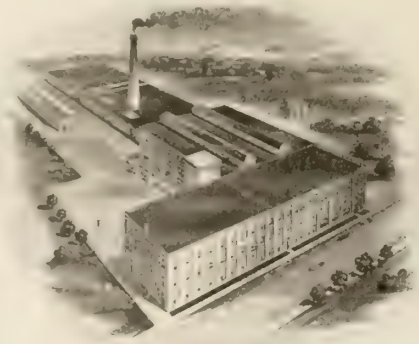

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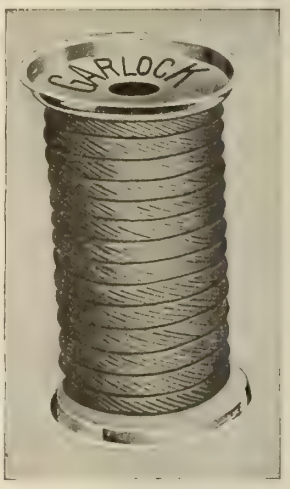

Be Guarded against loss and delay by reason of wasted steam, shut-downs for repairs. etc., by using packing of known reliability. Deception in the manufacture of packings is easily accomplished and your protection is to place your confidence in the packing that for more than a quarter of a century has been accepted as standard the world over.

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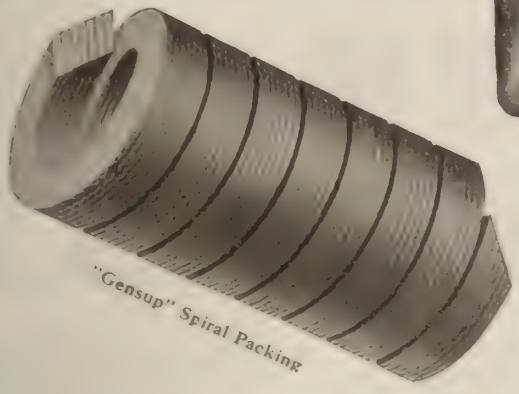
Pioneers in the Packing Business

Peerless Spiral Piston and Valve Rod Packing



"Gensup" Spiral Packing

"Gensup" Sectional Ring Packing

Conserve Your Power by Proper Packing

The loss of steam pressure through improper or poor packing becomes a very considerable item in a year's time

The General Supply Co. carries the most perfectly made packing for every purpose, of which a few kinds are described below.

"Gensup" High Pressure Jointing

PROMPT SHIPMENTS OF ALL ORDERS

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Recommended for use in connection with other rings, on rods that are scored or not running true, where pressure is not over 100 lbs.

Sectional rings are not practical where the ring is less than ½-inch wide.

NOTICE—Be particular to give diameter of Rod and Box exact. Specify if "Sectional" required, otherwise "Expansion" Rings will be sent.

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This is a sheet especially for superheat and the very highest pressures of steam, also for use on gas engines, ammonia, air, oils, acids, etc.

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It is not affected by heat and will stand any pressure. Will hold a joint when nothing else will.

In sheets about 5 feet square.

Asbestos Gaskets

"Peerless" Spiral Piston and Valve Rod Packing

You can get from 12 to 18 months' perfect service from Peerless Packing.

Will Hold 400 Pounds of Steam

This packing is adapted to general purposes where a round, durable, elastic packing is required.

Made of plies of duck, stoutly frictioned together over a red rubber core.

Put up in spiral coils in boxes.

Asbestos Gaskets

Any size, for manhole or handholes.

A high-grade gasket made from long fibre asbestos, rubber finish, with brass wire insertion, reinforced with copper wire rings.

Will not burn or blow out under any pressure, and on smooth surfaces can be used over and over.

"Negroid" High Pressure Sheet Rubber Packing

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The material from which this packing is made is a superior grade of duck and fine rubber, with a strong friction.

The lubricant is specially compounded.

Recommended for general conditions outside of high pressure steam.

Put up in spiral coils of 12 ft. each, in boxes.

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Oils and Alkalies are particularly hard on most sheet packings. "Negroid" is specially compounded to resist them. "Negroid" is designed particularly for high pressure steam, air, or water, and is one of the very best sheet packings made, for all purposes.

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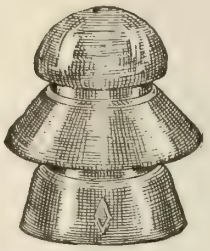
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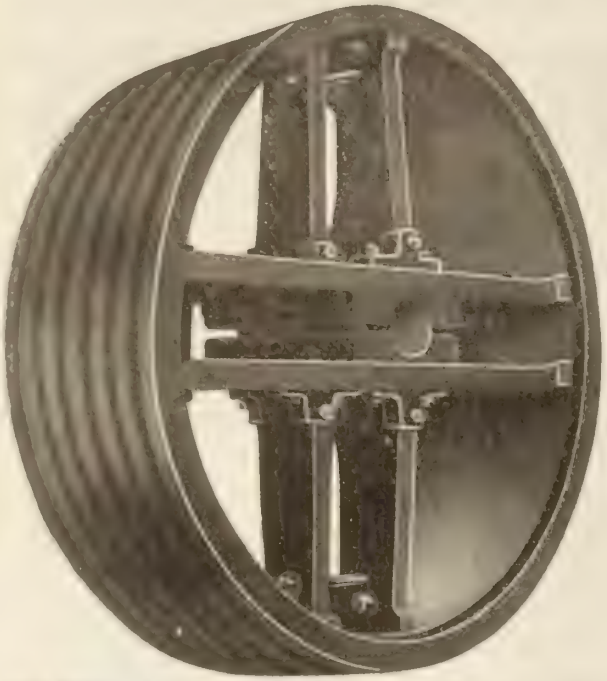

"ELMIRA" 4-ARM PULLEYS FROM 36 inch to 72 inch.

All "Elmira" Pulleys are guaranteed to be made of best material, run true, hold the shaft, and to be the strongest Pulley made.

The "Elmira" Pulley is nailed. Each segment has four nails, which pass through the adjoining segments. Besides eight nails, each segment is glued, by which is meant each segment is doubly glued. The glue is spread hot, so that it will be sure to set. The best glue is used and every barrel is tested before use.

Our Wood Split Pulleys

Have the arms properly tenoned into the rim, a perfect glue-joint being made, after which they are firmly doweled.

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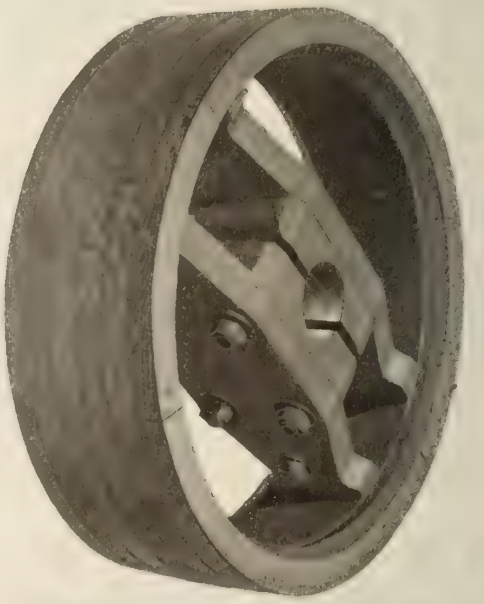
THIRTY DAYS' TRIAL GIVEN ON ALL ORDERS.



"ELMIRA" 2-ARM PULLEYS FROM 12 inch to 36 inch.

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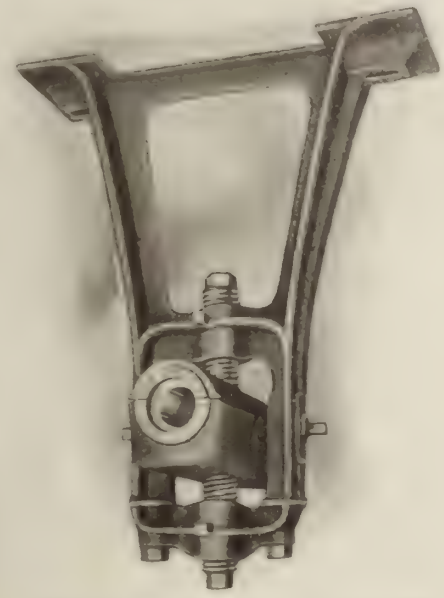
The ELMIRA MACHINERY & TRANSMISSION CO., Limited
ELMIRA ONTARIO

"ELMIRA" TRANSMISSION APPLIANCES



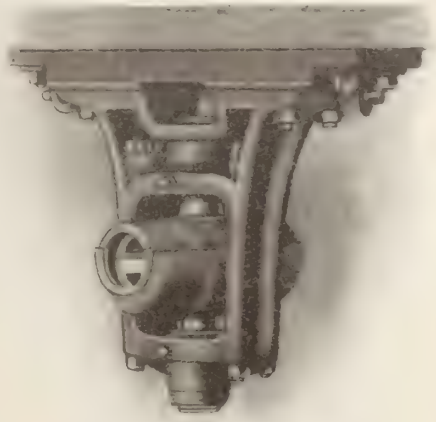
"ELMIRA" COMBINED CAPILLARY and RING OILING HANGERS.

In the "Elmira" Hanger a union system of oiling is employed, a combination of centrifugal and capillary attraction, effected by tempered steel rings and woven cotton wick. This method guarantees a thorough distribution of lubricant and precludes the slightest possibility of "Dry Bearings" so long as any oil remains in reservoir or oil chamber, one filling of which should last from six to twelve months.

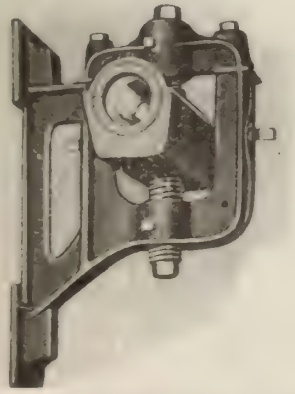
On the end of each bearing effective wipers are cast for scraping off and returning to reservoir all surplus oil.

The "ELMIRA" line of Hangers is without doubt the heaviest and strongest on the Canadian market, and while in no sense can they be considered competitive, their prices cannot do other than appeal to those desiring a strictly first-class article.

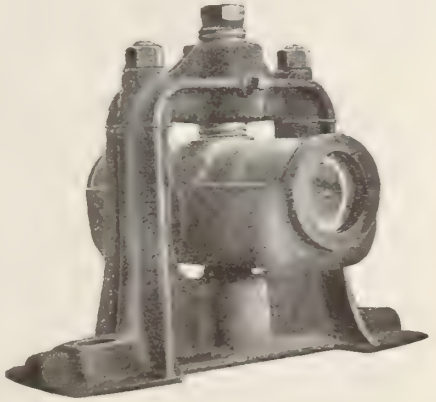
All Hangers have 2 inch vertical and one-half inch side adjustment. Length of Bearing four diameters of shaft.



"ELMIRA" HEAVY HEAD SHAFT HANGER.



"ELMIRA" ADJUSTABLE BALL and SOCKET POST HANGER.



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The ELMIRA MACHINERY & TRANSMISSION CO., Limited
ELMIRA ONTARIO

NELSON
TRADE-MARK REGISTERED

Combination Bronze Globe Valves

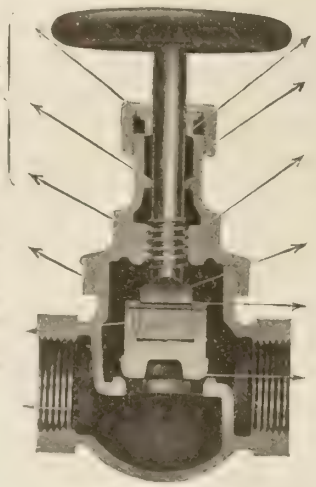
Send your order direct to us, if your jobber hasn't complete stock. We will take care of you.

Stem has bearing at three points in the bonnet, steadying it centrally, causing the disc to remain at all times correct with the seat.

Bonnet screwed on the outside of the body, protecting the body against internal strain.

This regrinding disc can be replaced easily with the rubber disc shown in valve below, or with the copper disc shown in valve at the bottom, on the right, all being renewable and interchangeable on the same stem at the same price.

See the wide hexagons and the long threads.



Gland Packed.

Large Packing Box.

All threads engaged with bonnet when valve is closed, when you apply the most pressure and *need the most strength.*

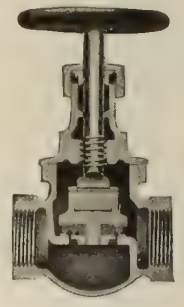
Chamfered shoulder makes tight joint with recess in bonnet when valve is wide open, so you can repack valve when under pressure.

To regrind, a nail through this hole prevents the disc from revolving on the stem.

Regrinding disc radial where it makes contact with the seat, preventing cutting of both disc and seat. (Cut shows valve slightly open.)

NELSON Valves are also made in the Gate and Check types for any pressure.

Showing the same valve with rubber disc.



Showing the same valve with copper disc.

For 175 pounds working pressure, each valve tested to 500 pounds.

NELSON Valve Company, Philadelphia

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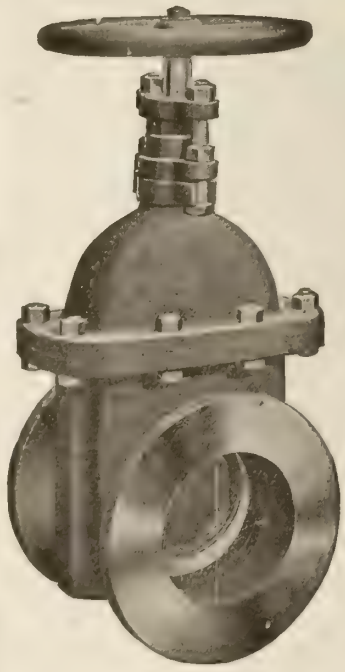

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are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

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The
Kerr Engine Co., Limited
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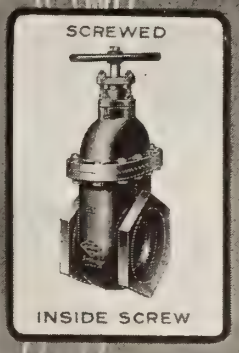
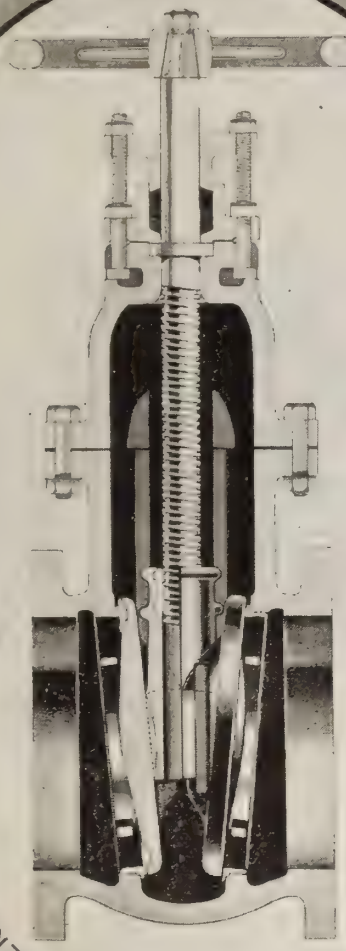
FULLWAY VALVES.

OPENS CLEAR TO FULL CAPACITY OF PIPE

CLOSE EQUALLY WELL IN UPRIGHT OR INVERTED POSITION





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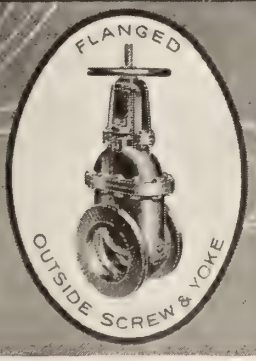
DISCS FACED WITH BRONZE DISC-RINGS FORCED INTO DOUBLE-GROOVED RECESSES

GATES CAN NEITHER JAM NOR CHATTER

GATES CLOSE POSITIVELY WITH BALL BEARING ACTION



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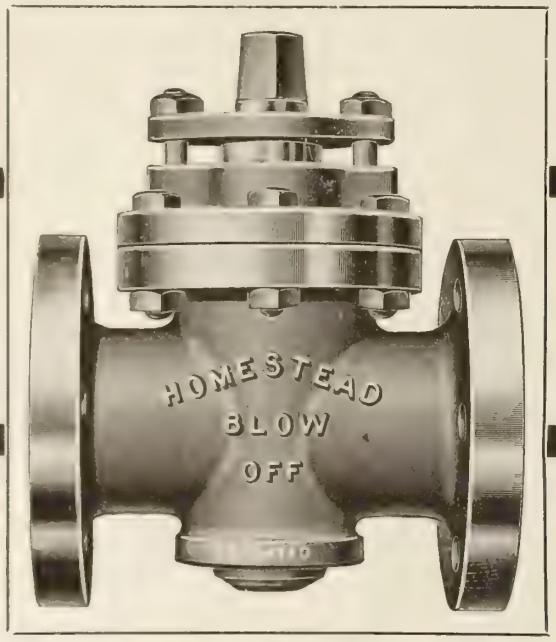

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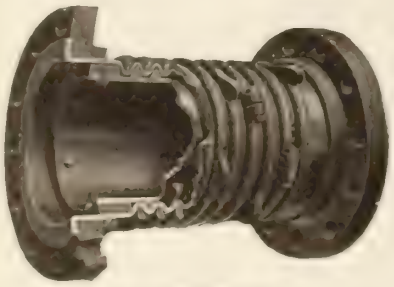

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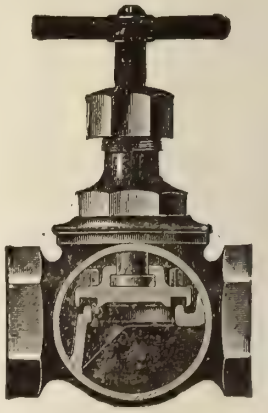

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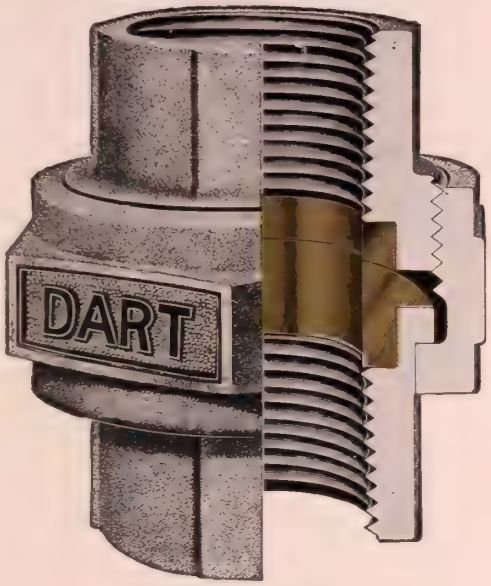

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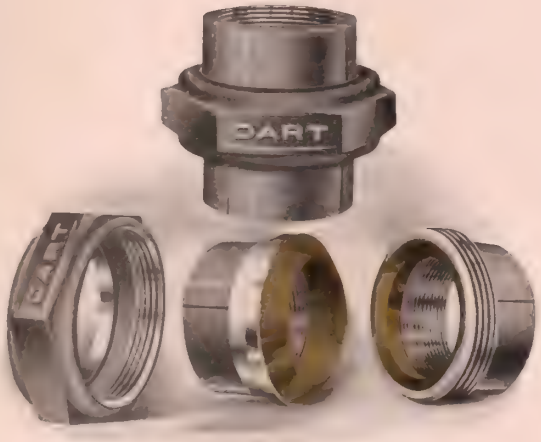
Pipe joint troubles and expense are eliminated by the use of Dart unions.

They make joints with the least bother, and when installed require no further attention. They are always tight, yet may be disconnected and connected as often as desired.

Absolute satisfaction with union joints is yours when you use Dart unions, and the name "DART" cast on the union will assure you that it is the genuine.



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The bronze to bronze joint of the Dart union will not rust or corrode, while the heavy iron parts prevent stretching or pulling apart. The ball-shaped seats permit the joint to be made either in or out of line.

Made in screwed, flanged, elbow and tee unions,
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Remember every Dart union is guaranteed 2 for 1 to give absolute satisfaction.

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FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

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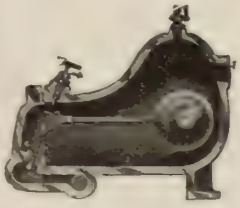

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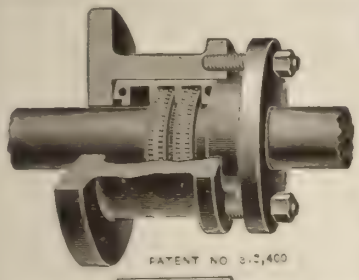

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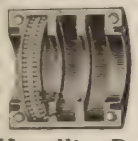

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Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

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A Cement that Withstands 3000° Fahrenheit

After several years' research and exhaustive tests in experimental work on High Temperature Cements, we have at last perfected and are ready to supply the trade with J-M High Temperature Cements in several forms to meet all conditions.

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hold a structure intact under the highest temperature. They will save at least 50% in maintenance costs. Are superior to fire clay and other similar materials, which fuse under heat, run and allow joints to open up, causing leakage and finally so weakening a structure that it is liable to collapse.

Why run such a risk with inferior cements that cause disastrous conditions? Write our nearest branch to-day, stating class of furnace, temperature, and troubles you experience, and we'll prescribe the remedy.

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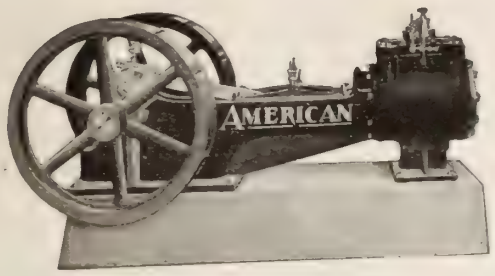

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FOR air lift systems, pneumatic tool service, machinery cleaning, and in fact every service where compressed air is used. these compressors have established an enviable reputation for EFFICIENCY, RELIABILITY and LOW COST OF MAINTENANCE.

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The Marsh Steam-Driven Air Compressors are equipped with the famous Marsh Self-regulating Steam Valve which proportions the amount of steam consumed to the work done by the air end, and is especially adapted to air compressor service.

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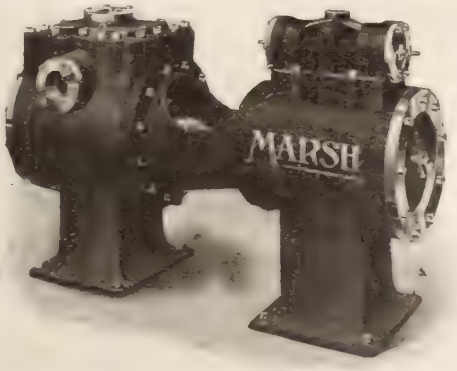

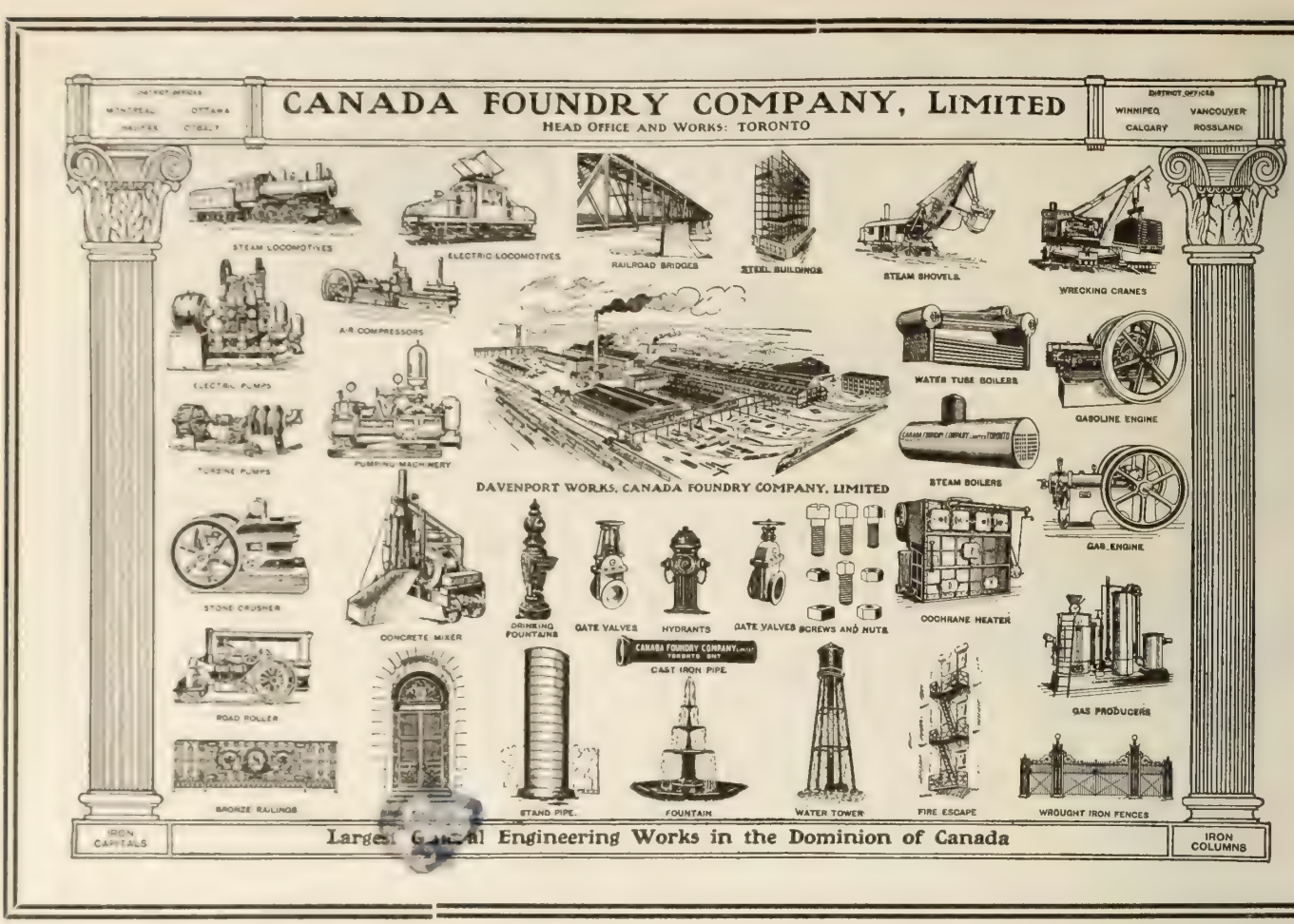

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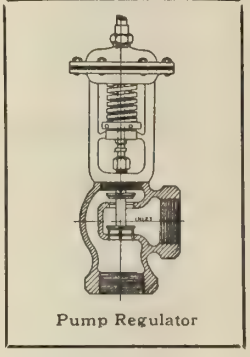
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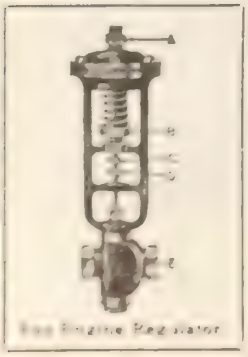
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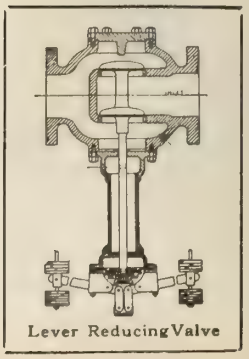
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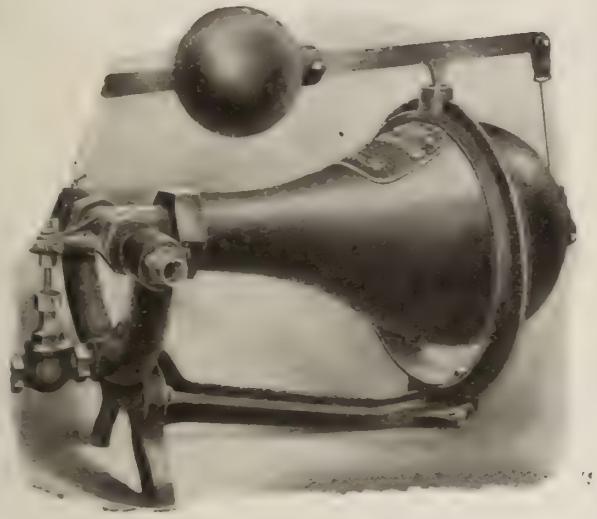

Why does the mere mention of the words

"Steam Trap"

at once suggest

"BUNDY?"

BECAUSE Bundy Steam Traps mean Bundy Service.

BECAUSE Bundy Service means Results to Bundy Owners.

BECAUSE A Bundy Owner is a Satisfied Owner.

BECAUSE This satisfaction is due to Bundy Service.

We are specialists in Condensation, and undertake all problems looking to greater efficiency and economy in Steam Plants of every description.

Catalogues and our pamphlet, "The Saving of Heat Units," are gladly mailed on request.

'Mason' Reducing Valves

are always
RELIABLE

Mason's All-Bronze Standard Valves reduce steam or air pressure from 300 lbs. or under down to any desired low pressure. And the Mason Standard Reducing Valve is exactly similar in construction except that the large diaphragm is sufficiently sensitive for use under the lowest pressures, EVEN BELOW the ATMOSPHERIC PRESSURE.

Write us for free illustrated circulars showing the unbeatable Mason line of Regulators, Reducing Valves, etc.

Genuine 'Ashton' Valves

are the World's Standard

Wherever steam power is used you will find Ashton Valves giving active and entirely satisfactory service. Being perfectly automatic in operation, simple in design and construction, and having no parts liable to accidental derangement, they are unquestionably the most reliable safety valves made. And they save steam-waste, too, by means of the "pop" chamber feature.

Write us for our illustrated catalogue of Ashton lines.

We are also ready to furnish expert service in connection with all questions relating to Heaters, Condensers (Steam and Ammonia), Shaking Grates, Special Engine and Ammonia Packings, and every form of pressure and temperature control.

H. L. PEILER & COMPANY

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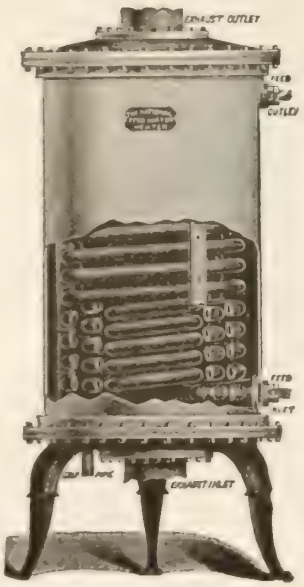
National
Feed Water Heater

RELIABILITY



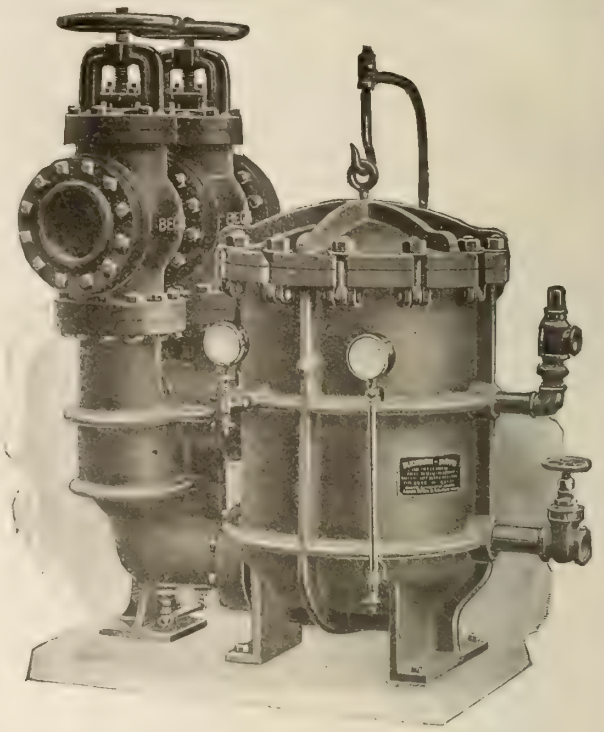
DURABILITY

The NATIONAL Feed Water Heater has proved itself to be the most simple, practical and efficient heater on the market. From one to fourteen coils of seamless drawn brass or copper tubing are encased in a cast-iron or steel shell to which exhaust steam is admitted, heating the water passing through the tubing. There is absolutely nothing to get out of order or corrode. This is the greatest fuel economizer on the market and will pay you to investigate.

Write at once for Catalog

The National Pipe Bending Company

91 Lloyd St., NEW HAVEN, CONN., U.S.A.



THE VITAL PART OF ANY FILTER IS THE FILTERING MEDIUM.

This must be **primarily** and **constantly** effective or full benefits from feed water filtration are impossible. The filtering material must, of course, be well adapted to retarding the suspended particles, but even then constant high efficiency is assured only where the filter can be quickly, easily and thoroughly cleansed. Charcoal, sand, burlap, straw, excelsior and the like, may give results **while fresh** but soon lose their efficiency and involve dirty, tedious work for renewal.

The Blackburn-Smith Feed Water Filter and Grease Extractor is free from such criticism. The filtering medium is linen terry, which is recommended by that well-known boiler insurance organization, the Fidelity & Casualty Co., in one of their publications as follows:

"Wherever the exhaust steam comes into contact with the feed water, or oily drips are returned to the boiler, an efficient oil separator or filter should be installed.

"Probably the most effective filtering medium is linen terry. This strains the water as it passes from the feed pump to the boiler. The terry may be removed, boiled in soda and used again."

No feature of the cleaning operation of a Blackburn-Smith filter furnishes an incentive for neglect, for, as Mr. H. W. Culver, Chief Engineer, Slater Bldg., Worcester, Mass., tells us, "One great advantage of this filter is the convenient way of changing the filtering cartridges, which only takes some minutes each time."

Let us refer you to plants in your neighborhood where the Blackburn-Smith Filter is doing good work under conditions similar to those in your plant. Or better yet, try one for 60 days at our risk. The results must be satisfactory or the filter may be returned.

Write for book "Feed Water Filtration."

Canadian Sales Agents

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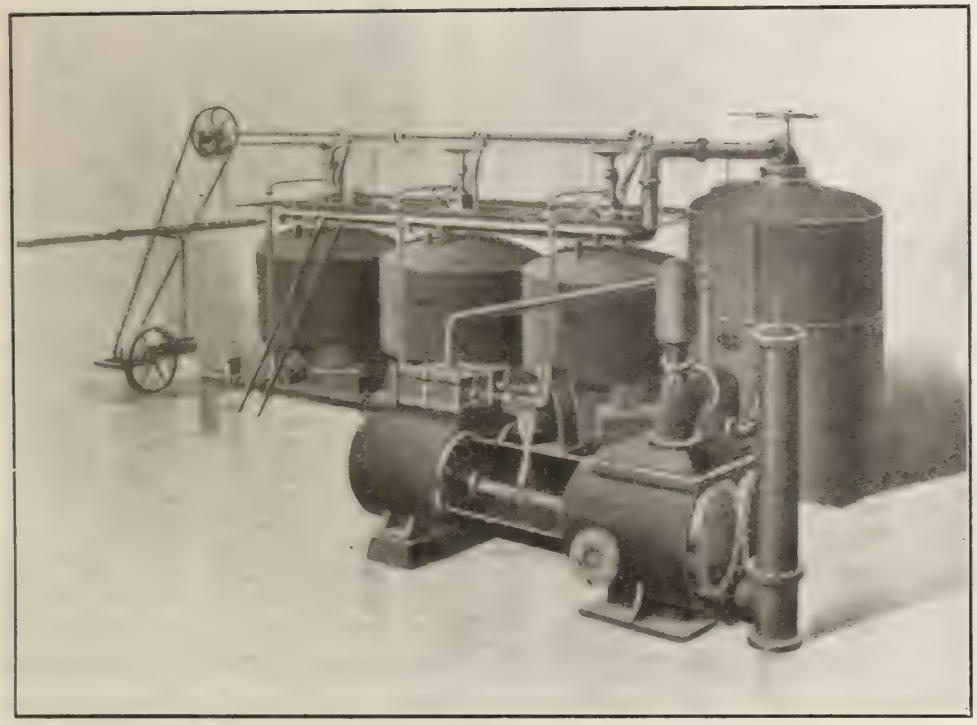
WATER SOFTENING, FILTRATION & PURIFICATION

For Boiler Feed and Manufacturing Purposes



Water Softening and Filtration Plant erected for a firm of Dyers and Bleachers. Capacity 600,000 gallons per 24 hours.

It consists of one Bell's Patent Pressure Settling Chamber, and three No 5 Bell's Patent Vertical Type Filters, with gear drive for rotating the hydraulic shafts, operated by a small horizontal steam engine, 5½ inch diameter cylinder, 10 inch stroke.

The sources of financial loss from the use of impure water for Boiler Feed purposes are, *Incrustation, Corrosion* and *Foaming,* all of whi.h mean:—

Increased Cost of Fuel
Increased Boiler Repairs
Increased time for Boiler Cleaning
and Shorter Life of Boiler

Prominent features of the BELL FILTRATION PLANT are its reliability of purpose and operation; its requirements of the minimum attention, its ability and capacity to obtain softness and purity of the hardest and most highly contaminated water, so that steam and other boilers may be kept entirely free from deposit and scale.

A conservative estimate places the average loss of fuel efficiency at 13% for every 1 16 inch of scale on heating surfaces. This applies equally to locomotive, stationary and heating boilers whether soft or hard coal is used for the generation of steam.

Manufactures, such as Bleaching, Dyeing, Brewing, Distilling, Sugar Refining, etc., are assured of the highest degree of purity of their various products.

The Filters are equipped so that they may be washed out each day or oftener; the operation involving only from 3 to 5 minutes, This ensures the filter sand being kept sharp, clean and effective, without which it is otherwise useless.

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UNCONDITIONAL GUARANTEE
MONEY SAVER

Cut down your fuel bills and heat your FEED WATER to a boiling point by using

The "OTIS"
TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER

It does its work rapidly and regularly and is built for service under any circumstances. The "OTIS" will also furnish steam for further heating purposes, and extracts all oil from the exhaust.

Write for descriptive catalogue on this superior money-saver.

The Stewart Heater Co.
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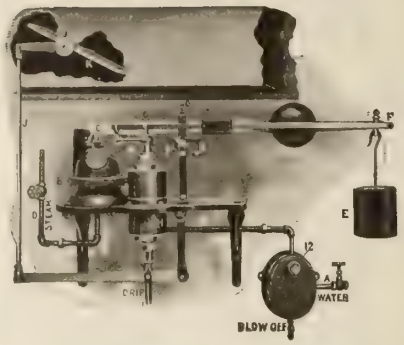
Regulate Your Dampers



WITH A

Stillman-Carmichael Damper Regulator.

The SAVING effected in FUEL by the installation of this Regulator will vary from 5 to 18% and the first cost is very small.

It will REGULATE High and Low pressure STEAM BOILERS, Blowers and Pumping Engines.

One Regulator will govern one or more Boilers. It will close or open wide the damper or dampers on a variation of ONE POUND of STEAM.

We furnish these Regulators subject to 30 days' trial.

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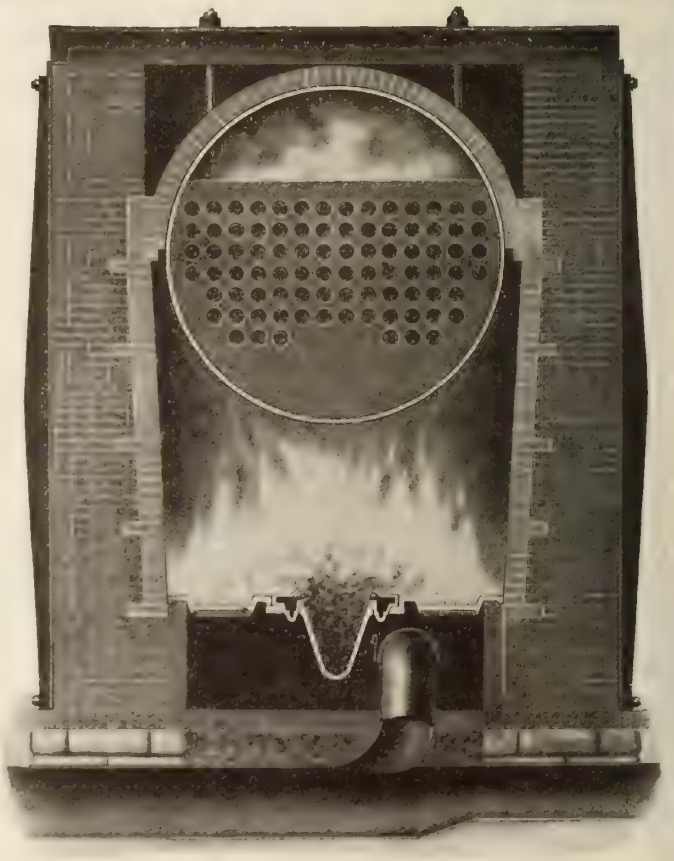
Winnipeg, Man. St. John, N.B. Toronto, Ont.

THE JONES UNDERFEED SYSTEM OF FIRING produces the highest obtainable degree of economy in the burning of Bituminous Coal.

"The proportioning of the fuel supply and the air supply is a requirement absolutely necessary to [illegible] perfect combustion!"

The Jones Underfeed Stoker System applies this identical principle in mechanical stoking, but going a step in advance, **THE STEAM PRESSURE ITSELF** automatically proportions the fuel and the air to each other, and to varying boiler loads, therein exercising **AUTOMATIC CONTROL IN ITS TRUEST AND MOST ABSOLUTE SENSE.**



The Jones Underfeed Stoker Co., Limited

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EVERY LIVE ENGINEER

Is anxious to effect Power Economies. One of the greatest wastes of the Power House is

UNCONSUMED SMOKE

One of the greatest economies that can be introduced is the

AUTOMATIC SMOKE PREVENTER

A. McDonald, Esq.,
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342 Craig St. West, City.

Dear Sir,

With pleasure we are glad to inform you that we are well pleased with the working of the Smoke Preventers and fuel Economisers that your Company equipped our two steam boilers with some time ago. It is a good steam producer and we have no smoke, which is a pleasure to us, as well as to our neighbours. We are using less coal on our two boilers with your device than we formerly used on one boiler. We have had two different devices on our boilers, which have proved unsatisfactory. We will be very glad to exhibit your device to any one referred to us.

Very truly yours,
JOHN WISFENDALL,
Superintendent,
Union Brewery.

Let us send you full particulars.

The AUTOMATIC SMOKE PREVENTION CO.,
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SURPRISING RESULTS!

Criss Cross Boiler Tube Cleaner

A guarantee of a certain saving of 10 to 15 per cent. in fuel accompanies every cleaner that leaves our shop.

It is the lowest in price and most effective cleaner manufactured to-day.

The arrangement of high carbon wire spirals with sharp obliquely set edges make the CRISS-CROSS Cleaner most effective in removing every particle of scale from your boiler tubes. Increased boiler efficiency and decreased labour and fuel costs are the result of its use.

Write to-day for full information.

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No Matter What Kind of Boiler You Have

THE Vulcan Soot CLEANER

will keep the heating surface free of soot.

¶ It will save you a good part of your monthly coal bill, enough in fact to pay for the Vulcan in short order.

¶ It is saving money every day for such concerns as The Grand Trunk Railway, National Breweries Limited, Standard Shirt Co, Dominion Textile Co., N. K. Fairbank Co, Geo. H. Hees, Son & Co., Toronto, Tavistock Milling Co., Montreal Cotton Co., Commonwealth Edison Co., and hundreds of others.

¶ It is in use in all parts of the country, in small and large plants.

¶ It does away with night cleaning work, with boiler strains due to entrance of cold air; it saves time and labor, and steam hose.

¶ It's a profit increaser and a work improver, a benefit alike to owner, engineer and fireman.

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Let us send you a copy---just mail the coupon to our home office.

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Mail the Coupon for this Book NOW

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Please send us, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.

(It is important that following information be given in full.)

Water Tube Boilers

No. of Boilers.....Type.....Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler).....
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Tubular Boilers

No. of Boilers.....Horizontal or Vertical.....
Name.....
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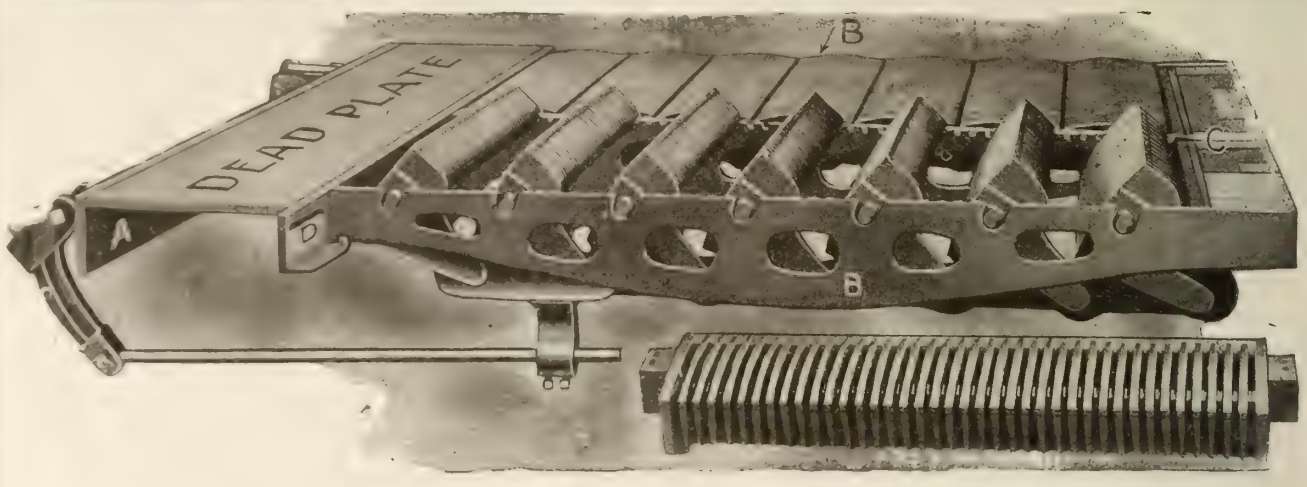
"THE Cyclone"

Shaking and Dumping Grate Bar



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We know this from the many letters we receive written by satisfied users. We can let you see these letters—they are as enthusiastic as even we could wish.

We know how to construct grate bars.

The "CYCLONE" Grate Bar never warps, and is always in working order, even after long use.

Its construction allows—

68% Air Space and 90% Under Draft

thus giving the maximum results from cheap fuel, such as soft or hard coal screenings; hard, or run-of-mine coal, coke, breeze, etc.

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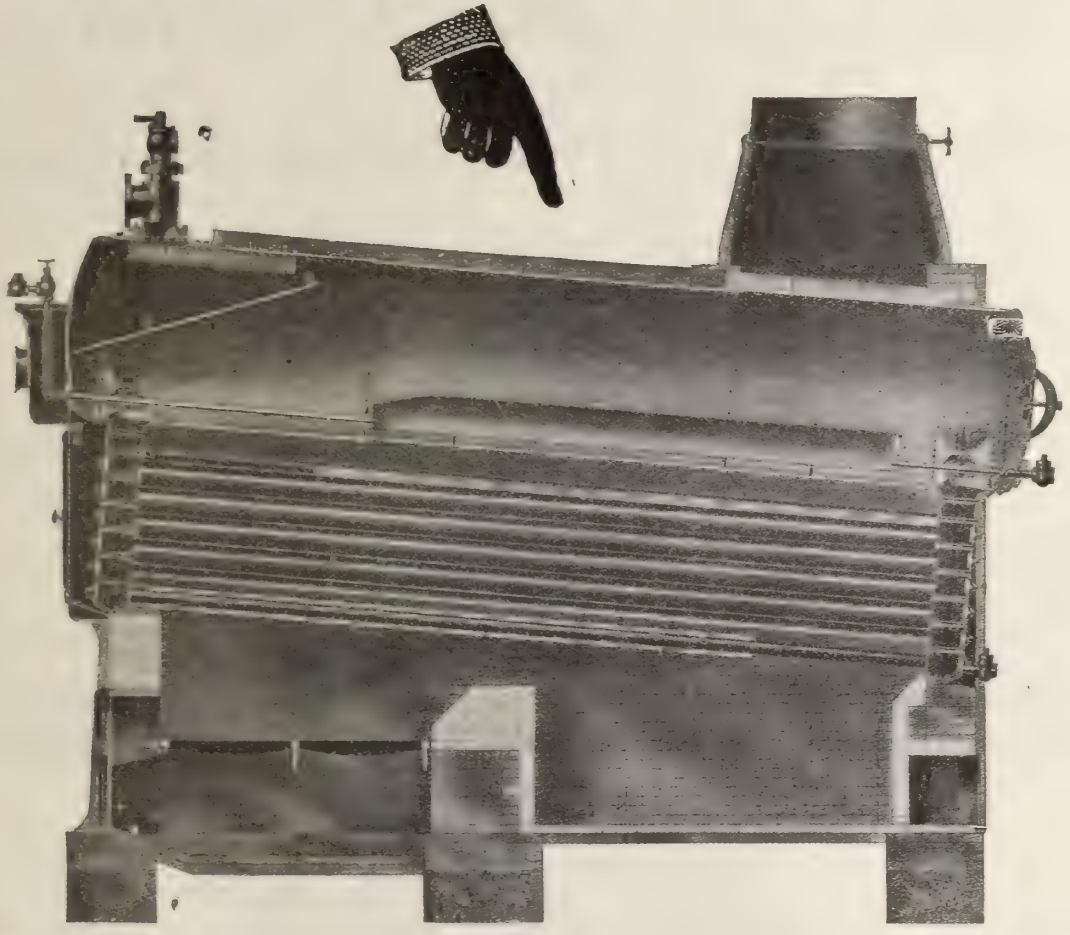

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is none too good for the HEINE SAFETY BOILER.

It has proved its worth for the best class manufacturers throughout the United States and Canada.

The HEINE Boiler absorbs more heat than others, with an even distribution of the water.

Needs less heat for a given generation of steam than any other boiler on sale to-day.

The HEINE Mud Drum is constantly at work, keeping the boiler clean by discharging all mud and scale, thereby preventing scale.

First, because they are best, and best because they are first, an investigation of the "HEINE" is imperative for those who require the best.

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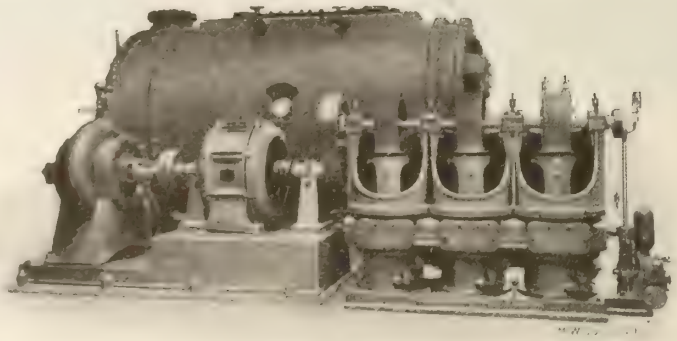

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BAROMETRIC LOW LEVEL JET or SURFACE

All on the Counter-Current Principle

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THE HEART OF A BABBITT METAL

THE United States Government made a radical departure from orthodox methods when they tested Magnolia, using water as a lubricant.

This test in connection with the tests they made, using oil as a lubricant, furnishes valuable comparative data.

For instance, in the oil test Magnolia showed only 25 per cent. superiority, antifrictionally; but in the water test it proved to be 200 per cent. superior to a high-grade babbitt of the conventional kind, and 1100 per cent. superior to white brass.

This demonstrates that a good lubricant will bolster up to a considerable extent even an ordinary grade babbitt, if plentifully supplied, but when water is used you get at the very heart of a babbitt, and prove its true inherent value. This is worth knowing, because the oil supply gives out sometimes, or the oil holes become clogged, or the quality of the oil is inferior.

Engineers who study these problems will realize that this wonderful showing of Magnolia was due to its very low co-efficient of friction. They also appreciate that a metal that does not become hot is not liable to squash, and wears very slowly.

We lay particular stress upon this quality of Magnolia, because it means safety and economy in every way, and minimizes loss of power.

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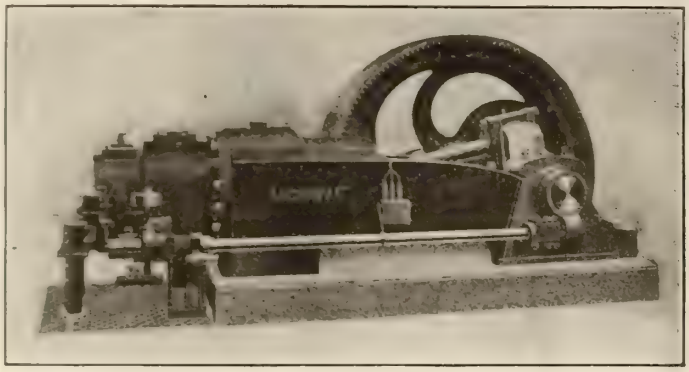
SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK: 680 pages, over 2000 subjects up to date. We do not aim to make a profit on this book, as it is an advertisement, therefore offer it at the very low price of 40c., postage paid. Many engineers pronounce it invaluable. Address Montreal office.



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Manufacturers of High and Slow-Speed Engines, Boilers, Heaters, Tanks, etc., etc.
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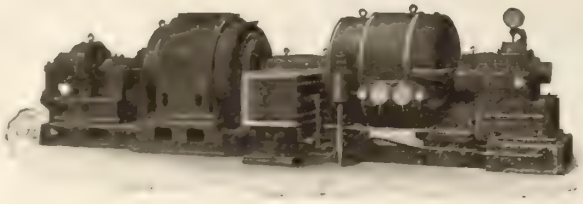

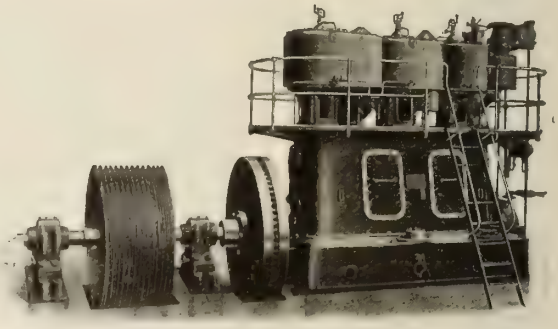

BELLISS TURBINES BELLISS ENGINES

BELLISS AIR COMPRESSORS

Every machine is built of the best materials procurable. The experience of thirty years and the improvements of most recent date combined result in machines of unequalled excellence.

Builders—BELLISS & MORCOM, Limited, Birmingham, England.

Laurie & Lamb,

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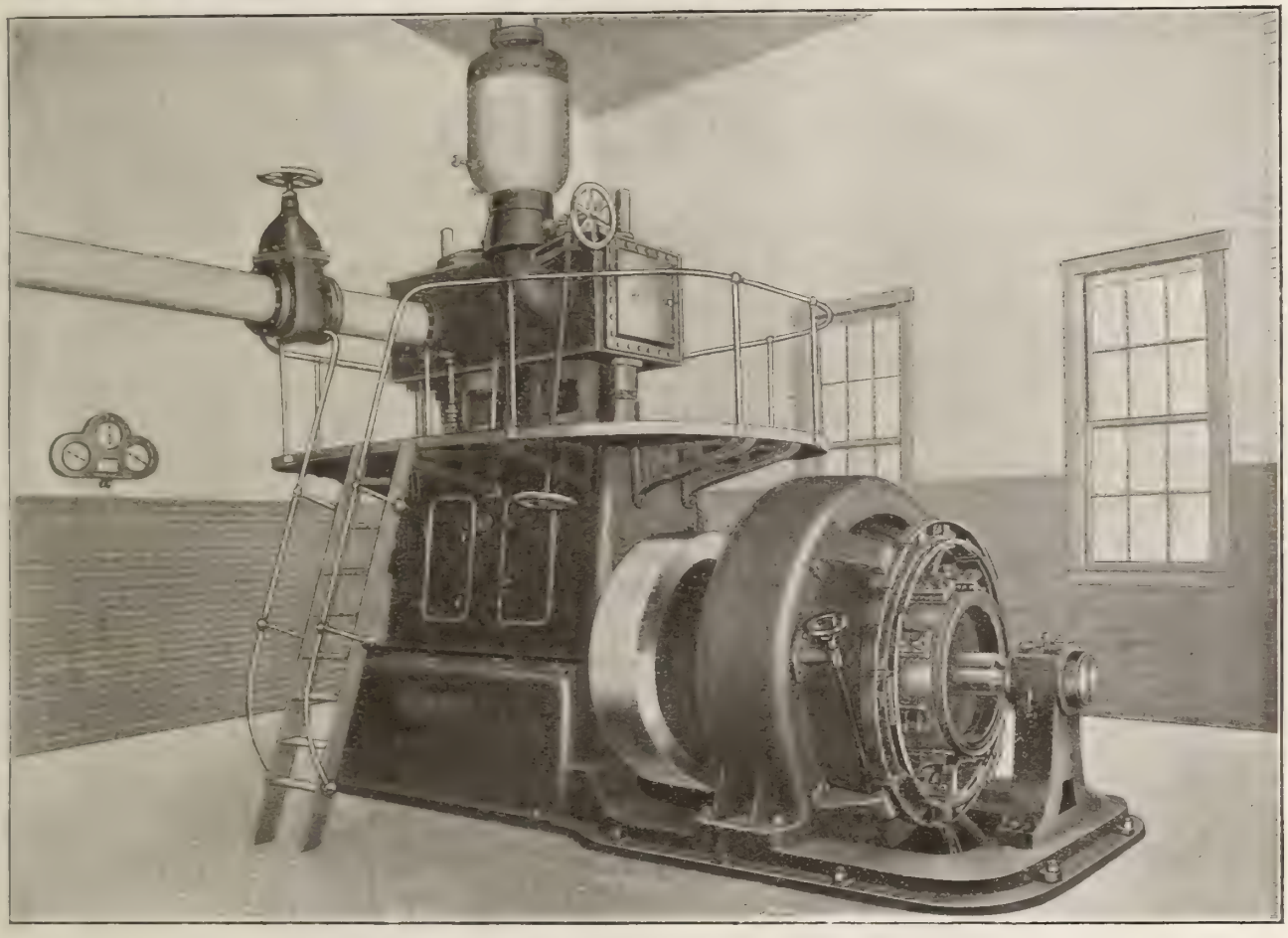
CONSULTING AND CONTRACTING ENGINEERS.

Robb Vertical Enclosed Engines



Simple
Two Crank Compound
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25 to 1,200 horse power
Oil Pressure 15 to 20 lbs. to the bearings
Interchangeable parts.

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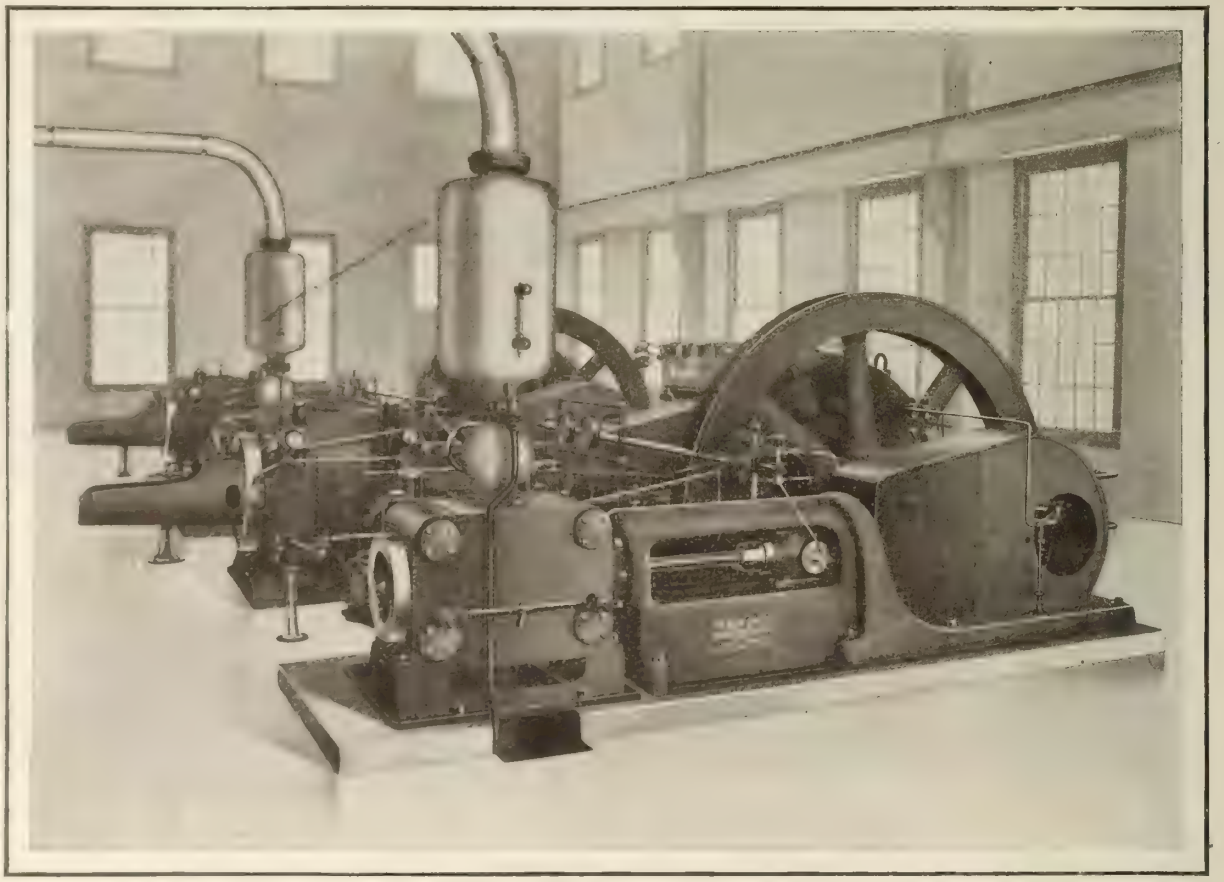
Don't fail to mention this paper in writing to advertisers.

Goldie Corliss Engines at Stratford

The power plant of the Grand Trunk Shops at Stratford is one of the principal points of interest to all visitors and delegates at the Engineers' Convention to be held in Stratford this month. Don't fail to see

THIS PLANT IN OPERATION.



TWO CROSS COMPOUND GOLDIE CORLISS STEAM ENGINES.
Heavy Duty Type. Each Direct Connected to a 400 K.W. Generator.

Our representatives at Stratford will be pleased to give all delegates and visitors a supply of Catalogues and any information required.

The Goldie & McCulloch Co., Limited

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WESTERN BRANCH
248 McDermott Ave., Winnipeg, Man.
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BRITISH COLUMBIA AGENTS
Robt. Hamilton & Co., Vancouver, B.C.

Don't fail to mention this paper in writing to advertisers.

Notes on the Coming C.A.S.E. Convention at Stratford, Ont.

The Spirit Which Animates and Leads a Man to Attach Himself to His Fellow for Purposes of Mutual Benefit and Protection is Worthy of Commendation. It Broadens His Outlook, Increases His Knowledge and Adds to His Usefulness, as an Employe and a Member of the Community in Which he Lives. Membership in the Canadian Association of Stationary Engineers is, we Believe, Conducive to Results Such as Have Been Referred to.

THE annual Convention of the Canadian Association of Stationary Engineers, will be held at Stratford, Ont., on July 25, 26, 27. Concurrent with the convention and co-operating, the exhibitors' association will as usual be in evidence with a display of the latest developments in power plant equipment, the outstanding and individually attractive features of which, will have tactful and effective explanation given by representative experts. Delegates have been appointed by the various lodges constituting the Canadian Stationary Engineers' Association, and while those only have voting rights, there is no reason why a large number of others should not be present to enjoy the privileges of seeing and knowing something of Stratford and its people, and partake of the general good time being provided.

The City of Stratford.

Among the medium-size cities of Ontario, Stratford stands out prominent as an important manufacturing, agricultural and dairying centre. The natural resources of the surrounding country are unexcelled, and offer ideal conditions for the establishment of a variety of industrial enterprises.

The manufacturing interests at present located, are large and representative in character, and give employment to several thousand skilled operators. Stratford is essentially a community of comfortable homes, has abundance of pure water pumped from artesian wells and a complete sewerage-disposal system. The streets are paved and the sidewalks, of modern construction, have modern public institutions and private buildings fronting them. Several handsome buildings are to be found in the business section. The city has a population of around 16,000, and an elevation of 1,150 feet above sea level.

Several important conventions have already been held in Stratford this summer, and the delegates of each of these have come, and gone away forcibly impressed with the hospitality of its citizens. This then is the city that has been chosen by the C.A.S.E. for their 1911 convention.

Stratford's Industries.

The geographical position of Stratford gives her an imperial position as a railroad centre, there being five lines of the Grand Trunk Railway running into the city. It therefore became imperative for the railroad to locate a repair shop. This has been done, and to-day Stratford is the proud possessor of one of the largest and best equipped railroad repair shops on the continent. The shops are under the management of Robert Patterson, who extends to all the delegates and visitors at the convention, an invitation to inspect the works. Another important industry, is the Geo. McLagan Furniture Factory. This is one of the best equipped in Canada, being fitted throughout with the most modern wood-working machinery for the production of high grade furniture. Employment is given to about 300 skilled workmen. Alex Scrimgeour, president of

W. G. WALTERS, STRATFORD,
Chairman, Entertainment Committee.

No. 31, is chief engineer. The Whyte Packing Co., of Stratford, is another industry of which this city can boast. From a comparatively small beginning, this company has, by a strict attention to business and the principle to produce the best under the best conditions, increased until it has attained to the position of one of the most important packing industries in the Dominion. The engineer in charge of the machinery equipment and cold storage system, is W. G. Walters. The Mooney Biscuit and Candy Co., is the largest factory of its kind in Canada. Wherever biscuits and candy are eaten, Mooney's is known. The engineer in charge is Oliver Poole. Other large and well equipped factories are the Mill Building Co., where the famous Brown engines are made; the MacDonald Mfg. Co., makers of threshers and traction engines; the Kemp Mfg. Co.; the Borland Mfg.; the Stratford Chair Co.; the Globe Wernicke; the Stratford Mfg. Co.; the Stratford Brigade Co., etc.

No. 31 C.A.S.E., Stratford.

A short history of No. 31 Lodge of C.A.S.E., is in order. The lodge was organized four years ago this month, with a membership of 17, Fred Chowen being the first president, followed by W. G. Walters, J. A. Robertson and Alex. Scrimgeour, respectively. The president-elect, 1911-1912, is August Kastella, chief engineer of the G.T. Power House. The present membership of No. 31 is about 40. A strong committee was appointed last December to arrange for and make the convention this year eclipse any previously held. Many important issues will come up for debate during this meeting, among which may be mentioned the annual or bi-annual convention ways and means of securing money for organization purposes; the graded certificate, and the advisability of changing the constitution so that only operating engineers will be eligible for election on the executive. Considerable fault has been found with the present system, which allows any delegate who belongs to the association, to become an executive officer; the consequence being laxity in the executive for the advancement of the operating engineer.

C.A.S.E. Entertainments.

The entertainment committee have completed arrangements for an historical event at the annual banquet and ladies are especially invited to attend this year's convention. The chairman of the entertainment committee, W. G. Walters, is well known to convention-going engineers. The souvenir is a handsome and instructive record of what is to be seen, heard and done.

The banquet will be held in the G.T.R. Assembly Hall, Downie St. Tickets will be furnished all delegates and visitors. Hon. Pres. R. Patterson, will take the chair.

On Wednesday evening there will be a grand entertainment for the ladies in the Princess. Stratford ladies of No. 31, will entertain visiting ladies in the C.A.S.E. hall, 1.30 p.m., Tuesday, July 25, when ice cream and cakes will be served.

C. A. S. E. Business Programme.

Tuesday, July 25th at 11 a.m. the opening ceremony of the convention will take place in the City Hall, when an address of welcome will be given by the Mayor of Stratford. Ladies, visitors and all delegates are invited to be present. An adjournment will be made at 12 o'clock until 1.30 p.m., from which latter time until 3.30 p.m. a C. A. S. E. session will be held. At 3.50 p.m. all delegates and visitors will assemble at the City Hall, afterwards proceeding to the G. T. R. shops for a tour of inspection, under the guidance of master mechanic, R. Patterson. In the evening at 8 o'clock, a banquet and entertainment will be provided for ladies, visitors and delegates.

J. A. ROBERTSON, STRATFORD,

Executive Conductor, C.A.S.E.

* * *

Wednesday, July 26th.—C. A. S. E. session until 12 noon. Inspection of exhibits will be made from 1 till 2.30 p.m., after which the delegates and visitors will be conveyed to the Queen's Park, to participate in the sports programme provided by the Exhibitors' Association.

[illegible] HAMILTON

[illegible], C.A.S.E.

At 8 p.m., in the City Hall, an open meeting and smoker will be held, at which papers will be read on the "Cost of Steam Power," by J. O. B. Latour, of the Canadian Casualty and Boiler Insurance Co., Toronto; on "Problems in Heating," by D. K. Dean, of the Alberger Condenser Co., New York; and on the "Operative Engineer's Ideal and Its Attainment," by Peter Bain, editor of The Power House, Toronto. Following the reading of the papers, discussion is invited.

* * *

Thursday, July 27th.—C. A. S. E. session until 12 o'clock noon. At 1.30 p.m. another C. A. S. E. open session will be held for installation of officers, presentation of past president's jewel, and general closing ceremonies.

Ladies' Entertainment.

One of the most important objects that the C. A. S. E. has in view is that of sociability, and in an endeavor to forward this side of the engineers' annual convention, Stratford has made arrangements to give the ladies the time of their lives. Delegates to the convention are most cordially invited to bring their ladies with them, and give them a chance to enjoy some of the good things that No. 31 has in store for them.

J. J. HEEG, GUELPH,

Executive President, C.A.S.E.

The following is a partial arrangement made for the entertainment of the ladies:

Tuesday, July 25th.

Opening ceremonies at City Hall, 11 a.m. Adjourn at 12 a.m.

1.30 p.m.—Reception in C.A.S.E. hall of all visiting ladies by the ladies of No. 31. Ice cream will be served.

3.30 p.m.—Tour through G. T. R. shops and power house, accompanied by the whole convention.

8 p.m.—Grand Banquet at G.T.R. Assembly Hall with splendid entertainment following, given by Stratford No. 31.

Wednesday, July 26th.

9.30 a.m.—Ladies will meet at City Hall where vehicles will be provided to show them Stratford the Beautiful.

WM. NORRIS, CHATHAM,

Executive Vice-President, C.A.S.E.

1.30 p.m.—Meet at City Hall to have their photos taken, conveyed to Park for sports and entertainment provided by C.A.S.E. Exhibitors' Association.

8 p.m.—Grand Entertainment in Princess Theatre with barrels of fun.

Thursday, July 27th.

9.30 a.m.—Meet at City Hall when they will be escorted through Mooney Biscuit & Candy factory.

1.30 p.m.—City Hall, closing ceremonies of the Convention.

W. G. WALTERS,
A. R. BENSON,
G. HIRD,
Entertainment Committee.

Exhibitors at the C. A. S. E. Convention.

T. McAvity & Sons, Ltd., St. John, N. B.; The Dart Union Co., Ltd., Toronto, Ont.; "The Power House," Toronto, Ont.; The Goldie & McCulloch Co., Ltd., Galt, Ont.; The Hill Publishing

A. M. WICKENS, TORONTO,

Executive Treasurer, C.A.S.E.

Co., Ltd., New York; The Dunlop Tire & Rubber Co., Toronto, Ont.; The Lunkenheimer Co., Cincinnati, O.; The Quaker City Rubber Co., New York; Jenkins Bros., Ltd., Montreal; Strong, Carlisle & Hammond; The Garlock Packing Co., Hamilton; The Eadie-Douglas Co., Montreal; The Cling-Surface Co., Buffalo, N. Y.; The Canadian Fairbanks Co.; "The Canadian Manufacturer"; "The Engineering Journal"; H. L. Peiler & Co., Montreal; The Morehead Mfg. Co., Detroit, Mich.; The Dearborn Drug and Chemical Works, Chicago; The James Morrison Brass Mfg. Co., Toronto.

Earl F. Hetherington, vice-president of the Exhibitors' Association, will be in charge of the exhibits, W. R. Stavert being unable to give his services on this occasion.

C. A. S. E. Executive Officers.

President—J. J. Heeg, Guelph, Ont.; vice-president — W. Norris, Chatham; secretary—W. A. Crockett, Mount Hamilton; treasurer—A. M. Wickens, Toronto; conductor—J. A. Robertson, Stratford; doorkeeper—H. R. Clark, Hamilton.

Exhibitors' Association Officers.

President—John B. Goff, the Dart Union Co., Toronto; 1st vice-president—E. F. Hetherington, the Goldie & McCulloch Co., Galt; 2nd vice-president—H. L. Peiler, the H. L. Peiler Co., Montreal; secretary—Gordon C. Keith, "The Canadian Manufacturer," Toronto; ass't.-sec'y.—D. O. McKinnon, Toronto; treasurer—George E. Fisher, Can. Fairbanks Co., London, Ont.; superintendent of exhibits — W. R. Stavert, Jenkins Bros.

THE EXHIBITORS' ASSOCIATION.

As usual the Exhibitors' Association are taking an active part in the C.A.S.E. convention, and in this connection have provided an interesting programme of sports for Wednesday afternoon, July 26th. The following is a list of the different events, together with detail of prize list:

CHAS. KELLY, CHATHAM,
Past President, C.A.S.E.

Sports Programme.

1. Three-inning ball game.—Engineers vs. Exhibitors. Mits, gloves, etc., prohibited and major league players barred. Winners will receive a box of cigars.

2. 100-yard dash.—Open to Engineers and Exhibitors. 1st prize, value $1.50; 2nd prize, value $1. Professionals and running shoes barred.

W. C. McGHEE
Past-President C.A.S.E.

3. Ladies' race.—25 yards. Open. No racing costume allowed. 1st prize, value $1.50; 2nd prize, value $1; 3rd prize, value 50c.

4. Relay race, 4 men team.—Distance between points 50 yards. 1st prize, value $1 each; second prize donated by E.F. Hetherington of Entertainment Committee.

5. Potatoe race.—Ladies only. Six potatoes to be gathered one at a time and returned to goal. 1st prize, value $1.50; second prize, value $1.00; 3rd prize, value 50c.

6. Donkey race.—To be run in teams of two, one carrying the other on back to given point, then changing places and returning to starting line. 1st prize, value $1 each; second prize donated by Geo. E. Fisher, of the Entertainment Committee.

7. Cigar race.—50 yards. Ladies and children barred. Object is to light cigar and reach the goal first. 1st prize, value $1.50; 2nd prize, value $1.

8. Three-legged race.—Lady and gentleman, 50 yards. 1st prize, value $1.50; 2nd prize, value $1; 3rd prize, value 50c.

9. Barrow race.—Ladies barred. 25 yards and return. Two men to a team, changing places at returning point. 1st prize, value $1 each; 2nd prize, value 50c.

10. Fat Man's Race, 50 yards.—Must weigh in all 200 lbs. or over. Waist measurement must not be under 42 nor over 60 inches. 1st prize only, value $1.00.

11.—Novelty race.—Pie eating contest. Open to all. The event of the afternoon. Special prize (valuable) 1st only.

12. Grand final, boxing tournament. No color line. Bouts will be one round each, and contestant must stand in barrel. The first prize will be the gloves.

13. Presentation of prizes.

Light refreshments will be served, and an official programme distributed on the afternoon of the sports, giving a list of the prizes, names of officials, etc.

Reading of Papers.

On Wednesday evening, papers will be read on the "Cost of Steam Power," by J. O. B. Latour; on "Problems in Heating," by V. K. Dean; and on "The Operative Engineer's Ideal and its Attainment," by Peter Bain, editor of The Power House.

Hotel Accommodation.

The entertainment committee report that plenty of good hotel accommodation is available in Stratford from $1.25 to $2.00 per day, and name the following hotels to which application should be at once made: The Albion and the Windsor, $2.00 per day; the Queen's and the Arlington, $1.50 per day; the Mansion, the Empire and the Commercial, $1.25 per day.

H. R. CLARK, HAMILTON,
Executive Doorkeeper, C.A.S.E.

Steam Turbine Adaptation for D.C. Generator Driving

By C. T. R.

A Discussion of the Various Types of Steam Turbine, With Regard to Their Adaptability to Direct-current Generator Drives Particularly, and Those of Low or Moderate Speed Machinery Generally. Readers Will Find This a Most Interesting and Instructive Article, Featuring as it Does to a Large Extent the Elements and Principles of Design Entering Into Each Turbine Type.

THE large size steam turbine has so far found application only for the driving of alternators and the propulsion of ships. Little progress comparatively, has been made in its adaptation for driving direct-current generators, and for direct connection to other machinery of moderate speed, such as centrifugal pumps and blowers, or driving of machinery by ropes and belts. While its suitability for these purposes, because of its simplicity, small weight and space requirements, good steam economy, and in recent years lower price, is apparent, the engineering world has nevertheless awaited until now, the practical solution of the problem of driving such machines by steam turbines.

Difficulties Involved.

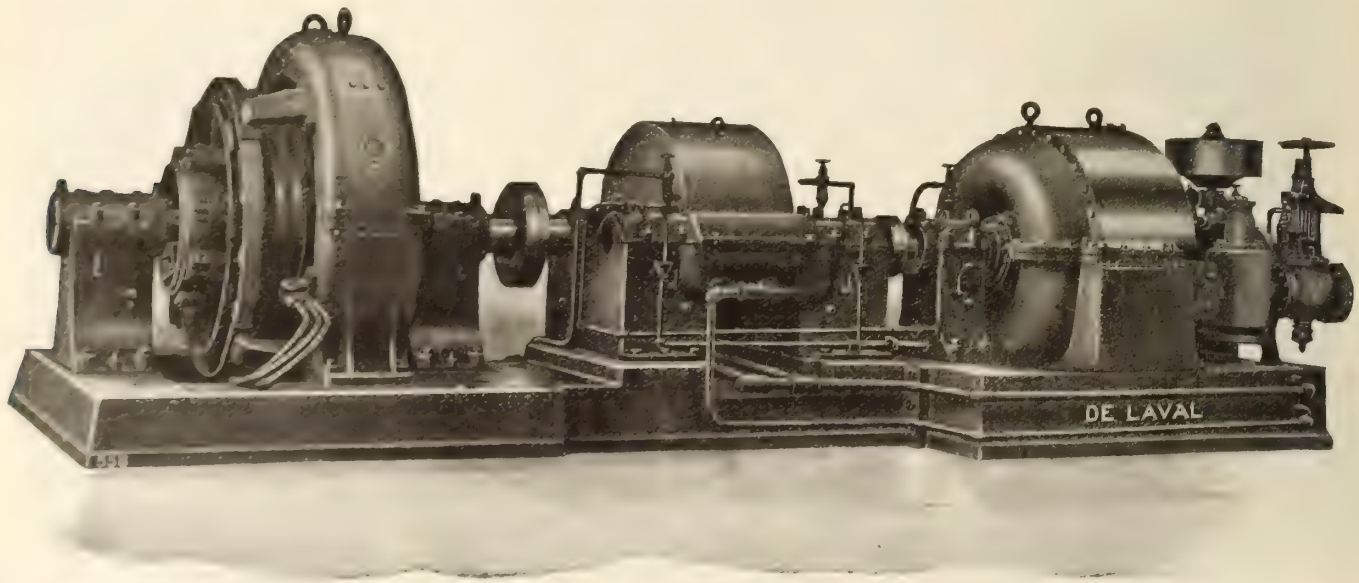
The nature of the difficulty is at once apparent from a simple statement of the velocities, etc., involved. The expansion of one pound of steam from 150 pounds pressure (164.7 absolute) to a 28-inch vacuum renders available for conversion into work, 325 B.T.U., equal to 252,850 foot pounds of energy. With expansion accomplished in one nozzle having unit efficiency, the resulting velocity of the steam will be 4040 ft. per second, If the jet of steam impinges upon a bucket standing still, it will exert a force upon the bucket equal to the flow in mass units per second (unit of mass pounds weight divided by the acceleration of gravity equals w) multiplied by

$$\frac{}{g}$$

the velocity with which the steam strikes the bucket, while the jet leaving the bucket will also be the cause of a reaction equal to the mass per second multiplied by the velocity with which the steam leaves the bucket. Although a pressure is exerted, no work will be done upon the bucket so long as the bucket stands still. If the bucket moves however, the forces exerted upon the bucket will, as before, be equal to the mass per second multiplied by the relative velocity with which the steam strikes the bucket, and the mass per second multiplied by the relative velocity with which the steam leaves the bucket, and the work done per second, will be equal to the components of the forces in the direction of motion times the distance traveled per second, that is, times the velocity of the bucket.

Should the bucket velocity increase until it be equal to the velocity of the steam in the direction of its motion, it will be apparent that no force can be exerted upon the bucket, since the relative velocity of the steam striking it will be zero. Between this extreme and the condition of standing still, there is a velocity of bucket, that will utilize the greatest amount of energy per pound of steam. With no change in the relative velocity of the steam while traversing the bucket, this velocity of the latter is one half the velocity of the steam in the direction of motion, a fact with which engineers are familiar in connection with impulse water wheels and the like. Assuming that the steam strikes the bucket in a direction tangential to the line of motion, this calls for a bucket speed of 2020 ft. per second, and if the bucket be mounted upon a wheel 3 ft. diameter, for a speed of 12,850 R.P.M.

As a matter of fact, the direction of the steam jet cannot be tangential to the line motion of the bucket, since that would imply zero area of nozzle, and as a practical matter, 20 degrees is found to be the least angle that is suitable. Again, the velocity of the steam leaving the nozzle is only about 97 per cent. of the velocity indicated by the thermodynamic theory, and the relative velocity of the steam leaving the bucket is, due to frictional and other losses while traversing the bucket, only around 80 per cent. of the relative velocity of the steam striking the bucket. Making allowances for the necessary entrance and leaving angles and for the losses due to friction, we find that the most efficient speed for the assumed case, would be around 1960 ft. per second. As this, however, would still be somewhat great-



The De Laval multicellular compound steam turbine driving Crocker-Wheeler D.C. generator, 500 k.w., 500 r.p.m., high pressure type.

er than the safe limit imposed by the strength of the wheel material. The wheel velocity actually used for high speeds is about 1400 ft. per second, un-

H. L. PEILER,
Vice-President Exhibitors' Association.

der wheel conditions about 75 per cent of the energy of the expanded steam will be transferred to the wheel. This wheel velocity, however, still corresponds to a speed, of 9520 R.P.M. for our assumed 3 ft. wheel, which would be usable for very few purposes.

Speed Reduction the Aim.

All the different types of steam turbines now on the market, arise from the attempt to solve the problem involved in reducing speed to practical use. A simple means would be to increase the size of the wheel; which suggestion has been made repeatedly. Actually, however, the wheel required is of prohibitive size from the standpoint of space occu-

GEORGE E. FISHER,
Treasurer, Exhibitors' Association.

pied, strength of materials and efficiency, since the large wheel would consume considerable power, on account of skin friction and windage of buckets.

Another solution in the order of simplicity, is to use gears to reduce the speed of the turbine wheel to that of the driven machine. This has proven eminently satisfactory in sizes up to about 750 H.P. and has resulted in the production of a most efficient type of turbine within this range of size, giving furthermore, low speeds that are practically unattainable by other means, and enabling the turbine to be directly connected to machinery of all kinds, and to be used for belt and rope driving.

Muti-Staging.

The third method of speed reduction is by "multi-staging," which has been carried out in three ways. The simplest is the use of so-called "velocity stages"; that is, the wheel instead of traveling

JOHN B. GOFF,
President, Exhibitors' Association.

approximately half as fast as the steam, travels, let us say, at one-eighth of the velocity of the steam, so that the rebounding steam will still possess three quarters of its original velocity upon leaving the first row of buckets. A stationary row of buckets then redirects the steam upon buckets carried by the next wheel, which abstracts another quarter of the velocity, and so on through four rows of moving buckets, theoretically, abstracting all the velocity. However, as pointed out above, there is a loss of velocity in traversing buckets, whether stationary or moving. If the velocity coefficient of the buckets is 80 per cent., the velocity would be so far expended at the end of the second row of stationary buckets, that it would not exercise any propulsive effect upon the third row of moving buckets. In other words, the velocity of the steam soon runs down, and the efficiency of a wheel carrying many rows of moving buckets would be very low. Steam turbines of this type are improved in effi-

EARL P. HETHERINGTON,
Vice-President Exhibitors' Association.

ciency by a partial adoption of the pressure stage method of compounding.

Pressure Stage Compounding.

This consists in the use of pressure stages instead of velocity stages. That is, the total pressure range, or rather energy, is divided up into parts, which are utilized in what are really independent turbines. The steam first experiences a partial pressure drop through a nozzle and then impinges upon a row of moving buckets, after which it passes through a second nozzle and impinges upon a second row of buckets, and so on. Inasmuch as the velocity of the moving steam varies as the square root of the energy converted into motion; dividing

GORDON C. KEITH,
Secretary, Exhibitors' Association.

the energy drop into four parts, would reduce the velocity only to one half, and to reduce the speed of the wheel to one quarter as in the preceding example, would require 16 stages, instead of 4. This method of speed reduction is also subject to losses of energy, for one reason, by the skin friction of the greater number of discs rotating in steam, some of which is at comparatively high pressure, and for another, the shaft carrying the wheels must pass from one chamber to another, and leakage will take place along the shaft where it passes through the diaphragms.

The Re-action Turbine.

The remaining method of speed reduction is one of the oldest. It differs from the multicellular type just discussed, in that the drop in pressure is not confined to the stationary nozzle, but there is a drop in the pressure of the steam while passing through between the moving buckets. In fact, as far as the relative action is concerned, it would be immaterial whether the casing stood still and the shaft rotated, or the shaft stood still and the casing rotated. This is the reaction turbine, so called because the steam enters the bucket with nearly zero relative velocity in the direction of motion of the bucket and the entire propulsive force is obtained from the reaction of the jets of steam escaping from the buckets on the low pressure side. The buckets should move with the velocity of the spouting steam, but as each pair of stationary and moving buckets gives in reality two pressures stages, the total energy drop is divided into twice as many parts as there are moving rows of buckets. Since the buckets move as fast as the spouting steam, and since the buckets in the single impulse wheel with which we started moved half as fast as the steam, if we are to get a speed reduction of 4 to 1 as in the other cases discussed, it will be necessary that the spouting velocity of the steam be one eighth of the spouting velocity obtained where all the energy is converted in one pressure stage, and since the spouting velocity varies as the square root of the energy drop, the energy drop per stage should be only 1-64 of the whole. However, since there are two pressure drops for each row of moving blades in this type of turbine, the number of rows of moving blades required will be 32.

Besides the great number of rows of buckets, the reaction type of turbine suffers from other disadvantages which are much more serious, especially with high-pressure steam. The principal of these is that, since there is a difference of pressure on the two sides of every row of blades, whether stationary or moving, there is necessarily a leakage through the clearance over the ends of the blades and further, since the large number of rows of blades calls for a long shaft, the clearance must be considerable in order to take care of possible vibration and distortion due to unequal expansion by heat, etc. Again, if the same angles are preserved throughout, the length of the blades increases directly as the volume of the steam, and since steam in expanding adiabatically from 150 pounds gauge to 28 inches vacuum, increases in volume in the ratio of 1 to 93, it will be seen that the low pressure blades will either be extremely long or the high pressure blades extremely short. This difficulty has been met to a certain extent by mounting the first rows of blades on a drum of smaller diameter, which, however, by reducing their velocity, increases the number of rows required.

The difficulty of providing for the increasing volume of steam is easily overcome in the case of a multicellular turbine, where there is no objection to us-

W. R. STAVERT,
Chairman, Exhibits Committee.

ing partial admission in the high pressure stages, while with the reaction turbine, such partial admission would result in subjecting the wheel to alternations of pressure during a revolution, which might set up serious vibration, and which would in any case, be accompanied by leakage of steam tangentially along the wheel from points of admission to points of no admission, and by consequent steam shock and lost energy.

Analysis for Speed Reduction.

We have then, to secure a speed reduction of 4 to 1, the following figures:—

For the pure velocity stage turbine, four rows, and for the multicellular type, 16 rows of moving buckets are required; while for the reaction type, 32 rows of moving buckets are required.

To illustrate the foregoing, suppose the problem be to obtain a driving speed of 600 R.P.M. from steam at 150 pounds gauge, exhausting to a 28 in. vacuum; that the admission angles are 20 deg. throughout, and that the blade coefficient is 100 per cent. The single wheel turbine will be 62 ft. in diameter. If a 3 ft. wheel is used with gear reduction, a gear ratio of 21 to 1 will be required. If velocity stages are used on a 3 ft. wheel there will need be 21 of them. If they are divided into two groups with pressure drop between, each will need to contain 14 velocity stages. If they are divided into three groups of pressure stages, each will need to contain 12 velocity stages. The multicellular turbine with pressure stages throughout, will, neglecting the fact that the friction loss in one stage is available as heat for the next stage, contain 440 stages. The reaction turbine will contain 1760 stages, that is 880 rows of moving buckets.

Single Stage Wheel Unsuitable.

The single-stage wheel, without gears, may be thrown out of the discussion, because of its size and the difficulty of construction. The single-stage geared wheel is entirely suitable in sizes up to about 750 H.P. as stated, but in sizes above that, it will be found, that unless the blades are made quite long or unless the angle of entrance is increased, the power of the wheel is strictly limited by the available area for the nozzle outlets. It should also be remembered that at the outlets, these nozzles must have an area corresponding to the final volume of the steam expanded down to 28 in. vacuum. Further, if the nozzle area is increased by increasing the length of the blades, the latter soon reach their limit of strength at the root for the speed employed, and as a third limitation at high powers, the speed of the shaft in its bearings would be excessive, considering the thrust which these would be called upon to withstand in transmitting the power to the gear, although this one objection may be over-ruled by the use of double gears, wherein the downward thrust of one upon the pinion is balanced by the upward thrust of the other, so that little, if any pinion thrust is transmitted to the bearings.

Multi-Stage Turbines Also Unsuitable.

When we come to consider the multi-stage turbines, it is at once seen that they are out of the question for any such speed as that named; the number of stages being so great that the shafts would be long and subject to vibration. There would be difficulties in regard to clearance, both from springing and from unequal contraction and expansion of shaft and casing, not to mention the cost, low efficiency, etc. For this reason, it has been the common practice to give over the attempt to force down the speed of the turbine after a certain point, and instead, to endeavor to bring up the speed of the driven machine.

In the case of alternators, this has been measurably successful, even though the speeds ordinarily adopted, viz., from 1,500 to 3,600 R.P.M. for sizes below 5,000 K.W. require long rotor drums, introducing difficulties of mass balancing, vibration of the shaft through unsymmetrical distribution of the magnetic field and high velocity in the bearings; insufficient space for coil windings, insulation and ventilating ducts; special difficulties in insulation peculiar to high speed, and resulting from compression of dust by centrifugal force; drying out of insulation, permitting the conductors to move in a radial direction; difficulties in making allowance for expansion and contraction of copper; difficulties in regulation due to too high saturation of the field magnets, etc.

D. C. Generator Drive Troubles.

It is with the direct-current generator, however, that the case becomes most serious. Among the many disadvantages of high speed direct-current machines may be mentioned the following:—

Proper commutation involves carefully designed construction, as the diameter of the commutator is limited by the allowable peripheral speed. It is usually necessary to use a double length commutator in order to obtain the requisite area and keep down the current density within satisfactory limits. The number of commutator bars and the distance required between brushes, limit the number of poles which may be used, and with very long commutators or with two commutators in tandem, there is difficulty in securing uniform distribution of current between the different brushes of each brush arm. Very careful shop work is also required. Again the increased length of shaft necessary to accommodate the commutator, increases trouble from vibration, which in turn interferes seriously with commutation, especially if carbon brushes are used. While it is difficult to compute the critical speed of a direct-current armature, it is very important that such speed be not approached, also that the commutator and armature be in perfect balance. Due to drying out or other change in the insulation after the commutator and windings have been assembled, there is generally a displacement of the centre of gravity which will give rise to vibration, and the necessity of limiting the diameter of the armature, restricts the space available for insulation and for armature winding, so that it is doubtful if the increased windage, iron losses and friction will be neutralized by a decrease in the purely electrical losses, which might be expected from the more compact construction and greater activity of the armature conductors. Due also to the very high speed at which the armature must run, and the necessity of passing a large amount of air through it in order to keep it cool, there is a great tendency to collection of dust, including carbon dust from the brushes, and it is found that under high speed conditions, this dust assumes a very compact form, which frequently results in short circuits or grounds. Finally, while the standard speed electrical generator is entirely familiar to the ordinary operating man, who can make such small repairs as may be required, the repair of the high speed generator is entirely beyond both his knowledge and his facilities. In fact, the majority of dynamo designers appear to be of the opinion that direct-current units of 1,000 K.W., should not exceed a speed limit of 600 R.P.M., and this speed has in fact been found most suitable, also for smaller machines down to 500 K.W. These speeds, however, are altogether too low for the ordinary turbine, for as pointed out, they involve an excessively long turbine or otherwise the efficiency must be greatly sacrificed, and moreover, a turbine of 4 to 6 times this speed, would, on account of its shorter shaft and other factors, be easier, as well as cheaper, to build with a given factor of safety.

Practical Advantages in the Use of Superheated Steam*

By H. G. Bertram, B.Sc.

Showing that Cylinder Condensation is Reduced to an Almost Negligible Quantity When Superheated Steam is Used in Preference to Saturated Steam. The Writer Discusses the Question in Simple and Easily Intelligible Language, Requiring but Little Application and Study on the Part of Our Readers to Grasp the Situation.

THE principal losses in the steam cylinder have been attributed to two causes:—

(a) Condensation due to the hot steam striking the cool walls.

(b) Leakage past the piston during stroke.

Saturated Steam and Condensation.

Of these the first is most complicated since there is an interchange of heat from and to the steam during each stroke, nevertheless the general action may be illustrated by a simple example.

Suppose we have a vertical cylinder, Fig. 4, open at the top, fitted with a weightless and frictionless piston, whose area is one square foot, and so arranged that it can be loaded to exert any desired pressure on the fluid under it. Let the cylinder and piston be of cast iron 1-64 inch thick, so that the weight of the piston and cylinder bottom equals 1.17 pounds, and the cylinder barrel 2.06 pounds per foot height. Assume the piston loaded, so that the pressure under it is 115 pounds per square inch and imagine that the cylinder has been taking steam for some period of time; exhausting into the atmosphere, and at the end of an exhaust stroke has a temperature of 212 degs. F.

If we introduce 1 pound of steam at 100 lbs. gauge pressure below the piston, and leave condensation out of the question, the piston will rise to a height of 3.8 feet, since from the steam tables, 1 lb. dry saturated steam at the above pressure occupies 3.8 cubic feet and the area of the piston is one square foot.

The work done therefore would be

$144 \times 115 \times 3.8 = 63{,}000$ ft. pounds.

In the above, we assume that there is no heat interchange between the steam and the cylinder walls, but since the steam enters at 338 degs. and the walls are at 212 degs. Fah., it is evident that heat will be extracted from the steam until the walls are at the higher temperature. This quantity of heat can easily be calculated. Weight of cast iron in piston, bottom of cylinder and 3.8 feet of barrel=9 pounds. Change in temperature = 338—212 = 126 degs. Specific heat of cast iron = .1298 or .13, therefore heat required to make the change = $126 \times .13 \times 9 =$ 147 B. T. U.

Continuing the calculation,—the heat of vaporization of 1 pound of water at 100 lbs. gauge is 876 B. T. U., and abstracting 147 B. T. U., would reduce

$\frac{147}{876} = .168$ lbs. of steam to water at 338 degs. Fah., leaving $1 - .168 =$ .832 lbs. of steam in the cylinder. Now .832 pounds would only occupy $.832 \times$

* Third article of a series. The fourth paper will deal with the practical advantages from the standpoint of piston leakage.

3.8 = 3.16 cubic feet, and the piston instead of rising 3.8 feet would only rise 3.16 feet, and the work done would = 144 × 115 × 3.16 = 52,400 ft. lbs.

If we wish to force the piston up to the original height, the .168 lbs. of condensed steam must be replaced by more

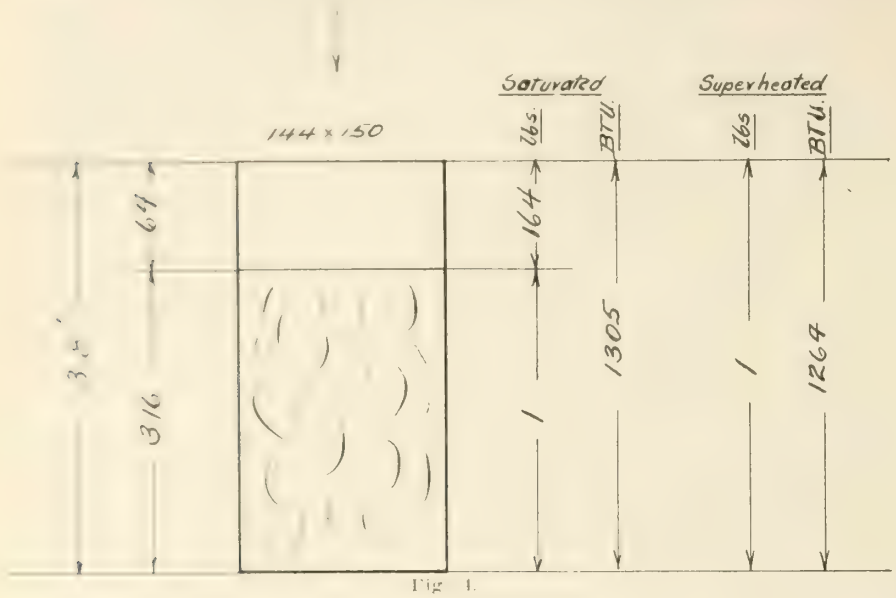


Fig. 1.

from the boiler and we must use 1.168 lbs. to do the same work that 1 lb. would do without condensation. Condensation thus means an increased steam consumption of 16.8 per cent. or practically 17 per cent.

Before going further, however, it must be understood that this calculation is merely for a cylinder with thin walls and a slowly moving piston. In the actual engine, this loss is not so great, because the walls are usually lined and so will hold heat. With a high piston speed it is impossible for the iron to change completely from one temperature limit to the other during a single revolution.

Superheated Steam and Condensation

During each revolution of condensation may occur during all the engine, we will now see what the result would be if the steam were superheated. It is quite evident that it would be an advantage to have the steam carry into the cylinder sufficient heat to satisfy the demands of the iron without being condensed, and this can only be accomplished by superheating.

Returning to our imaginary cylinder, it required 147 B.T.U. to raise the temperature of the metal from 212 to 338 degs. F., and if we assume the heat of superheated steam to be .5, it will be necessary to have $\frac{147}{.5}$ = 294 degs. superheat; that is, the temperature of the steam will be 338 + 294 = 632 degs., instead of 338 degs. F. No change being made in the pressure, the one pound of superheated steam will raise the piston 3.8 feet, and do the same amount of work as 1.168 lbs. of saturated steam.

The saving in steam consumption will therefore be

$$\frac{1.168 - 1}{1.168} \times 100 = 14.4\%.$$

Superheat Means Higher Cost.

We may not stop here, however, for although there is a saving of 14.4 % in the quantity of steam used, it becomes necessary to supply more heat to raise the temperature to the higher level. It costs more to secure a pound of superheated steam than it does a pound of saturated steam, for the simple reason that the former contains more heat, and therefore requires more coal. From the paragraphs on the specific heat of superheated steam, it follows that the cost varies with the pressure and degree of superheat. In the case under consideration, the heat in 1.168 pounds of saturated steam at 100 pounds gauge pressure, in excess of a feed water temperature of 100 degs. F. is 1.168 × (1,184—68) = 1,305 B. T. U. 1.168 being weight of steam 1184 = total heat in 1 lb. of steam above 32 degs. F. 68 = rise from 32 to 100 degs. F. = 100 — 32. Heat in 1 pound of steam under the same conditions plus a superheat of 294 degs. = 1 × (1116 + (.5 × 294) = 1263 B.T. U.

From this the heat saving would only be

$$\frac{1305 - 1263}{1305} \times 100 = 3.2 \text{ per cent.}$$

This saving appears small as regards economy, but the calculations demonstrate that by giving up superheat instead of latent heat, condensation can be avoided in the cylinder.

Transfer of Heat.

As in the case of the calculations for saturated steam, no account has been taken of the actual transfer of heat that takes place; it being assumed that the metal changes from one temperature to the other. If we examine the operation of an actual engine using superheated steam, we will find that the transfer of heat is very much less than in a similar engine using saturated steam. This is explained by the fact that superheated steam is like a gas, and consequently a poor conductor of heat. It gives up heat slowly to dry

72-inch riveted steel pipe, 168 feet long, for Toronto water intake.

metallic surfaces, and is equally slow in being cooled by the metal. In the short time required for one revolution, the cylinder absorbs far less heat when it is kept dry, than when covered with a thin film of moisture.

Attention is directed to these latter points, and to the necessity of keeping the cylinder walls dry, at least during steam admission, that being the period when condensation is greatest with saturated steam.

With this in view, we would naturally expect the best results from the use of superheated steam in a cylinder of small diameter and long stroke, where the surface exposed is greater relatively to the volume, than in a cylinder of larger diameter.

RIVETED MILD STEEL INTAKE PIPE.

The Canada Foundry Co., Toronto, has recently completed the 3,000 feet of riveted steel pipe ordered by the city of Toronto, for the water supply intake from Lake Ontario. The pipe is 72 inches internal diameter, and was made up in lengths of 168 feet; each length consisting of twenty-three mild steel plates, $\frac{5}{8}$ inches thick. The longitudinal and circumferential seams are lap-joint, and double riveted with 1 inch rivets. At the ends of each length is riveted a 6 x 6 x 1 inch cast steel angle ring, which forms a joint with the next length by means of $1\frac{3}{8}$ inch bolts.

On account of the large amount of space required for erection, each 168 feet unit was assembled in the works yard. Special pipe lines carrying compressed air and fuel oil were laid to supply the riveting hammers and rivet heating furnaces; and work continued night and day until the job was completed. The illustration shows one of the lengths on two flat cars for shipment.

ALBERTA BOILER REGULATIONS.

We have received from the Government of the Province of Alberta several copies of the 1911 Regulations for the Construction and Inspection of Steam Boilers.

The booklet is of pocket size, has 66 pages, and is neatly bound in stiff covers. Constructional, setting, fittings, and inspection details are fully covered, and reflect a large amount of labor involved in the endeavor to ensure boiler laws of a high and safe standard.

In addition to the boiler booklet, there has also been issued in pamphlet form a list of manufacturers whose designs for boilers and accessories have been approved, together with a complete list of these latter. Altogether, the Province of Alberta has shown commendable zeal in tackling with a strong hand, this all-important subject.

Gas Producer and Gas Engine Plant Costs

A Comparative Statement Covering First Cost, Weight per Horse-power and Annual Operating Expense of Gas Engines Running on Producer Gas, and Steam Engines of Reliable and Well-known Types.

THAT gas engines operating in combination with a gas producer equipment, are as power-generating units more costly to install, is the almost generally accepted opinion held by engineers. Wm. O. Webber writing in the "Iron Age" recently, furnished some interesting data, and drew attention to a number of important features in the comparison between this form of power generation and that of the steam plant. What follows, consists of a few extracts from Mr. Webber's article.

The figures given in the first table include all auxiliaries, foundations, setting, piping, cartage, freight, etc., but not the cost of the land, buildings and generator, as these are the same in either case.

Comparative First Cost.

Horsepower of plant.	Cost of steam plant.	Cost of gas producer-vertical gas eng. pt. Belted.	Direct con.
34	$100	$132	$150
66	90	99	112
100	85	76	88
140	80	69	76
190	75	68	73
280	70	68	76
380	65	68	73
420	63	69	75
500	62	..	*84
620	60	..	*86
1,000	65	..	*90

*Horizontal.

The comparative weights per horsepower of gas and steam engines are as follows:

Weights Per Horse Power.

Horsepower.	Pounds per horsepower vertical gas engines.	Do., direct-connected Corliss steam engines
60	240	148
140	275	143
190	280	140
300	290	140
*500	300	250
750	300	213
1,000	340	213
1,200	350	215
1,500	375	219
2,000	400	210
2,500	400	250
3,985	400	270

*Horizontal.

The cost of operation, assuming fuel and labor to be the same for both types of plants; with coal at $5 a ton, and labor varying, is given as follows. Fixed charges are also included.

Cost Per Horsepower Per Annum.

Horsepower.	Labor.	Steam eng.	Gas producer gas engines.
20	$30	$146	$75
40	20	120	42
60	15	105	38.65
80	12	95	35
100	12	86.40	30
200	10	77.10	27
300	8.60	69.22	25
400	7.25	61.90	24.5
500	6.20	55.29	24
600	5.40	49.28	23.5
700	4.70	43.79	23
800	4.15	39.73	22.5
900	3.75	34.05	22
1,000	3.50	29.80	21.5
1,500	3.25	25.77	18.75
2,000	3.00	21.75	17.25

Coal Consumption.

In gas producer-gas engine plants the coal consumption varies from 1 lb. in the largest sizes, to $2\frac{1}{2}$ lb. per h.p. per hour in the smaller sizes; in steam plants it varies from 12 lb. in a small 20-h.p. plant to 7 lb. in a 100-h.p. plant, 5 lb. in a 500-h.p. plant, $2\frac{1}{2}$ lb. in a 1000-h.p. plant, and 2 lb. in a 2000-h.p. plant, where strict account is kept of all the coal used throughout the 24 hr., including the banking of fires during the night and the standover losses in both cases.

Water Consumption.

The water consumption of gas engines is larger than generally supposed, being practically the same per h.p. as for the steam plant. For the smaller sizes, 5 gal. per engine h.p. per hour for the jacket water to probably about 4 gal. on the larger sizes is required, besides which a similar amount must be used in the producer per h.p. for washing purposes. The steam plant uses about 5 gal. of water per h.p. per hour for the simple plant, down to 3 gal. per h.p. per hour on a condensing engine of 200 or 300 h.p. or over.

In condensing plants, approximately 26 times the water used by the engine is required by the condenser. All the waste heat escaping from the steam boilers is lost, except such as is utilized through a feed water heater, or an economizer, or in building heating during the cold months. At present, in a gas engine, quantities of gas as great as 800 cu. ft. per h.p. per hour are wasted at temperatures of from 1000 to 1800 degrees. These waste gases from the gas engine could be absorbed preferably in heating hot air, which might be utilized by being blown around the buildings for heating purposes, or in heating water

Getting rid of the cylinder jacket cooling water, so that the same water can be used over and over again is readily possible by using cooling towers of the open type, placed upon exposed parts of the roofs of buildings and forcing the water there by electrically-driven centrifugal pumps. A cooling of 10 deg., as a minimum, to 30 deg., as a maximum, accomplishes all that is required, and can be very inexpensively done by constructing a wooden cooling tower, where sprays of water are caused to fall over a set of louvres into an exposed tank, from which they flow by gravity to the jacket spaces.

Relative Economy.

There is no question as to the relative economy of gas producer-gas engine plants, as these can be made to reduce the cost of power from one-third to one-half. All plans and specifications should [illegible] by carefully drawn and enforced by a competent, disinterested engineer. Nothing less than a 30-day run should ever be accepted as a practical performance of any plant, and such performance should always include a period at the average load as it occurs, a period of at least a week at the capacity of the plant, and a period of at least 24 hours at the maximum which the plant might be forced up to in case of emergency or breakdown

PACKING POINTERS.

A babbitt metal or brass ring in the bottom of the box of an outside packed plunger, is a great aid to packing. It will pay for itself many times over, not only in cost of packing, but also in the general neatness and cleanliness around the pump.

When using packing with high pressure or superheated steam, it is not advisable to use cylinder oil as a regular lubricant. A mixture of cylinder oil and graphite is good, the cylinder oil simply serving to help flow the graphite into position. The graphite gradually fills in the smaller pores of the rod and levels them up, making a smooth surface. The smoother the surface, the less friction there will be between the rod and the packing.

Some engineers make a quick and permanent joint out of a self-vulcanized packing by turning on three or four pounds of steam after the joint is made, and when the joint is thoroughly warmed, dashing a few buckets of water over it, thus cooling the flange and the packing. This causes the packing to harden into position at once. It is a quicker process than that of self-cooling.

Packing if treated right will do a great deal of good honest labor for its master; but if forced, it balks and will not work. A man should be patient with packing, and use it very carefully until it thoroughly conforms to the shape of the box. If it is given plenty of room and well lubricated, it will last for years; but if squeezed into a confined space and run dry, it will soon lose its life.

It is a good plan for every engineer to keep a little note book in which he has tabulated the diameter of every rod, the diameter and depth of its stuffing box, and the size of the packing required. This enables him to make out an order quickly, and at the same time with certainty. The measurement of a rod in motion, is always guess work. It is also a good plan to number each box that requires packing, and keep extra packings on shelves in the order of the number, so that it can be quickly found in case of emergency.

A good engineer can pack with almost anything. A poor engineer can spoil the best of packing. An engineer, who treats carefully the packing which he puts in and takes care of it as he would a new suit of clothes, will find that it will stand by him and give good service. But if he abuses it, particularly with the unwise use of a wrench, he will find that it will wear out very quickly. "Patience" and "carefulness" are the watchword of success with packing.

Before inserting a packing ring, it should always be dipped in cylinder oil. The advantage thus obtained, far more than compensates for the corrosive effect of the oil. The oil as a lubricant, prevents excessive friction and allows the packing to place itself in position without being burned, and while the oil will affect the rubber, it will not produce as quick and disastrous an effect as the excessive heat, which would occur if no lubricant were used.

Some engineers make a practice of placing sheet packing in position on a flange and then cutting the edges with a hammer. This is very poor practice, as it leaves a bruised and ragged edge on the rubber which has a tendency to tear. The best way of cutting is to first mark the outline of the gasket on the sheet and then to cut with a sharp knife. This leaves a clean cut edge and lessens the danger of a blow-out.

When drawing up a gasket, draw the bolts up gradually and on all sides, so that the two flanges approach each other as nearly parallel as possible. If a gasket is drawn up tighter on one side at the start, the gasket is distorted and a probability of blowing out is almost assured. If there are eight bolts in the flange, draw number 1 partly, then skip to number 5, then to number 7, then to number 3, and then to the intermediate bolts. Repeat the same process, drawing them a little tighter. Repeat again setting them up in position.—The Mechanical Rubber Co. Catalogue.

The Bell Filtration Co. of Canada Limited

The growing tendency towards water purification for domestic and industrial purposes is not the least prominent among the many betterment movements which the cities and towns of the Dominion of Canada are seeking to inaugurate. Water for domestic purposes is far from being what it ought, and that for manufacturing can stand considerable improvement by purification and softening, so as to not only enhance quality but economize cost as well.

The Bell Filtration Co. of Canada, represeotatives of Bell Bros., Calder Ironworks, Manchester, England, the well known filtration and water softening engineers, have opened offices in the Kent Building, Toronto; at 188 Peel street, Montreal, at 150 Princess street, Winnipeg, and at 18 East Seventeenth street, New York.

The headquarters of the company is Toronto, and Mr. Rowland Houser is general manager. Mr. Houser together with Mr. Edmondson, chief engineer of Bell Bros., have been interviewing and putting their proposition before city and consulting engineers all over the Dominion, and as a result, much prospective work is already showing.

The design and construction of the Bell filter combines in its leading features a certain and thorough system, whereby the sand medium cannot fail to take hold of all impurity in suspension. Further, and perhaps more important, is the facilities provided, whereby the sand is cleansed in a few minutes with the minimum of labor and inconvenience.

In addition to water purification and softening for domestic use, equipments to suit all sizes of manufacturing and steam power plants form part of the company's field of operation. The high purification and softening which they are prepared to guarantee, makes attractive such an outfit in the realm of fuel economy and boiler preservative.

The loss of fuel caused by scale in steam boilers may in a general way be averaged as follows:

Scale 1-64-in. thick causes a loss of 2 per cent. of fuel.
Scale 1-32-in. thick causes a loss of 4 per cent. of fuel.
Scale 1-16-in. thick causes a loss of 9 per cent. of fuel.
Scale ⅛-in. thick causes a loss of 18 per cent. of fuel.
Scale 3-16-in. thick causes a loss of 27 per cent. of fuel.
Scale ¼-in. thick causes a loss of 38 per cent. of fuel.
Scale ⅜-in. thick causes a loss of 48 per cent. of fuel.
Scale ½-in. thick causes a loss of 60 per cent. of fuel.
Scale ⅝-in. thick causes a loss of 74 per cent. of fuel.
Scale ¾-in. thick causes a loss of 90 per cent. of fuel.

NEW SOLDER IN PASTE FORM.

There has recently been placed on the market a new solder in paste form, and put up in collapsible tubes like the familiar tooth paste tube. The process of application consists in squeezing some of the paste on to the surface to be heated, and which has been already prepared by slightly scraping with a knife. A match, candle or torch creates sufficient heat to fuse and solder as in the case of the old style soldering stick. The name of the new product is "Solderall," and the H. W. Johns-Manville Co. are distributors from their various branches.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV JULY, 1911 No. 7

CONVENTION TOPICS.

Prominent among the questions which we presume will be discussed at the C. A. S. E. convention, to be held in Stratford in the latter part of the present month, will be that of graded certificates. Not many, we think, will be found in the minority against; at the same time, no matter how small the latter may be, or how near to unanimity the majority, thorough discussion of the subject and carefully laid plans for propagating and maturing the movement, so as to bring early consummation of satisfactory result, should be the aim of the delegates in session. The Power House, as the Canadian power plant operative engineers' medium of publicity, may be relied upon to give all necessary help and encouragement to this and every effort which has for its aim the improvement and welfare of the engineer's profession. The movement for graded certificates has originated among engineers themselves, and thus expresses forcibly that desire for betterment is real determined. Schemes launched by individuals or corporations with the idea of improving the social or moral condition of people outside their own sphere, lack that snap which is always apparent when the movement has its birthplace within the people themselves. Graded certificates are an incentive to higher effort, and lead to intelligent study of engineering problems.

THE ANNUAL OUTING.

A number of lodges of the C. A. S. E. have been taking advantage of the "good old summer time" and forgetting for a brief space the engine room and its attendant and insistent demands on their head and hands. Outings have been largely in evidence, and no one reading the account of London, No. 30's, doings on another page of this issue, can fail to realize that London is really "burning"; yes, but with enthusiasm. It is quite apparent that the Canadian Association of Stationary Engineers is doing healthy, fraternal and uplifting work throughout the Dominion, and that its individual members are each contributing their share.

This is, to some extent, the off season, so far as study is concerned, and while it is not altogether desirable that study should be entirely stopped, we cannot help but sympathize with the temporary shut-down; the more so, in view of the tropical weather we are experiencing. Answers to questions in our special department are, we note, not receiving the wide-circled response that cool days and evenings bring to our desk, although in view of the almost certain enactment in favor of graded certificates, every advantage should be taken to keep the educational standard on the move toward betterment.

The summer outing is a fitting finish to the labors of a society's winter work, and marks, by its almost coincident election of new officers, the first move towards another year's progress and attainment.

CHEAP POWER IN TORONTO.

We are entirely in sympathy with Mr. Yerbury's views on the question of "cheap power for Toronto." His letter on the subject, published in our June issue, is timely, and will, we hope, do much to counteract the misrepresented all-sufficiency and almightiness of this much boosted Hydro-Electric. It can't be too forcibly expressed that cheaper power is available, and the Hydro-Electric, like every other business proposition, does not exist "for the good of its health" or for the good of the people of Toronto, except in-so-far as it is expedient.

It has been aptly remarked that even apparently staid people laud and adore the promoters of this Hydro-Electric, as if they were second only to the Maker of the Universe.

Boosting, like chickens scratching on a marble floor, will make little lasting impression, however,. Our biased friends may just as well sit back and get busy to tackle something more in their own line, and leave the consumer to settle his course of action from his own economic viewpoint.

It seems to be forgotten that power users are out for the power generation apparatus that will pay them best now, and that on this ground only must the Hydro-Electric rates be judged. Whether the Toronto Electric have been brought to their knees or not, is of minor importance to a man who can lick both of them. Too much attention is being directed to coal and oil supply exhaustion, and under cover of it, opportunity is taken to knock steam and internal combustion engines.

The vision of harnessing Niagara until not a drop comes over the falls, leaving a bare, steep cliff, is dangled in front of our imagination to help sound the deathknell (?) of "power generation by fuel combustion."

It is altogether too obvious, this "drumming out" business. Power generation by fuel combustion is a serious competitor of Hydro, and as Mr. Yerbury shows, the latter has to come some to meet this competition. We are not seriously worrying as to when the supply of combustion peters out, but we do want now the cheapest and most dependable power with which to carry on our business. Glorifying this or that promoter, and knocking this or that opposition, are each uncalled for, and show weakness and bad taste; besides being unbeneficial to any. Mr. Yerbury speaks from knowledge, and is in a position to prove his contentions to the hilt. His opponents have yet to be heard from, and no irresponsible need apply.

Progress and Development of Hydraulic Engineering

By Penstock

No Apology is Necessary for Our Featuring Hydraulic Engineering in Canada. This Country Lends Itself Naturally to a Development and Progress Along the Lines of Every Description of Water Power Equipment, and the Idea in This Particular Section of Our Paper is to Make Known What is Doing and Who is Doing it Throughout the Whole Field.

TURBINE PUMP NOTES.

The increasing use of centrifugal and turbine pumps makes necessary an intimacy with the principles of design, construction and operation, on the part of those whose sphere of work lies to a lesser or greater extent in these directions. To the operator particularly, the following details, extracted from Bulletin publications of the John McDougall Co., give clear and concise information on important and vital points.

Measurement of Head.

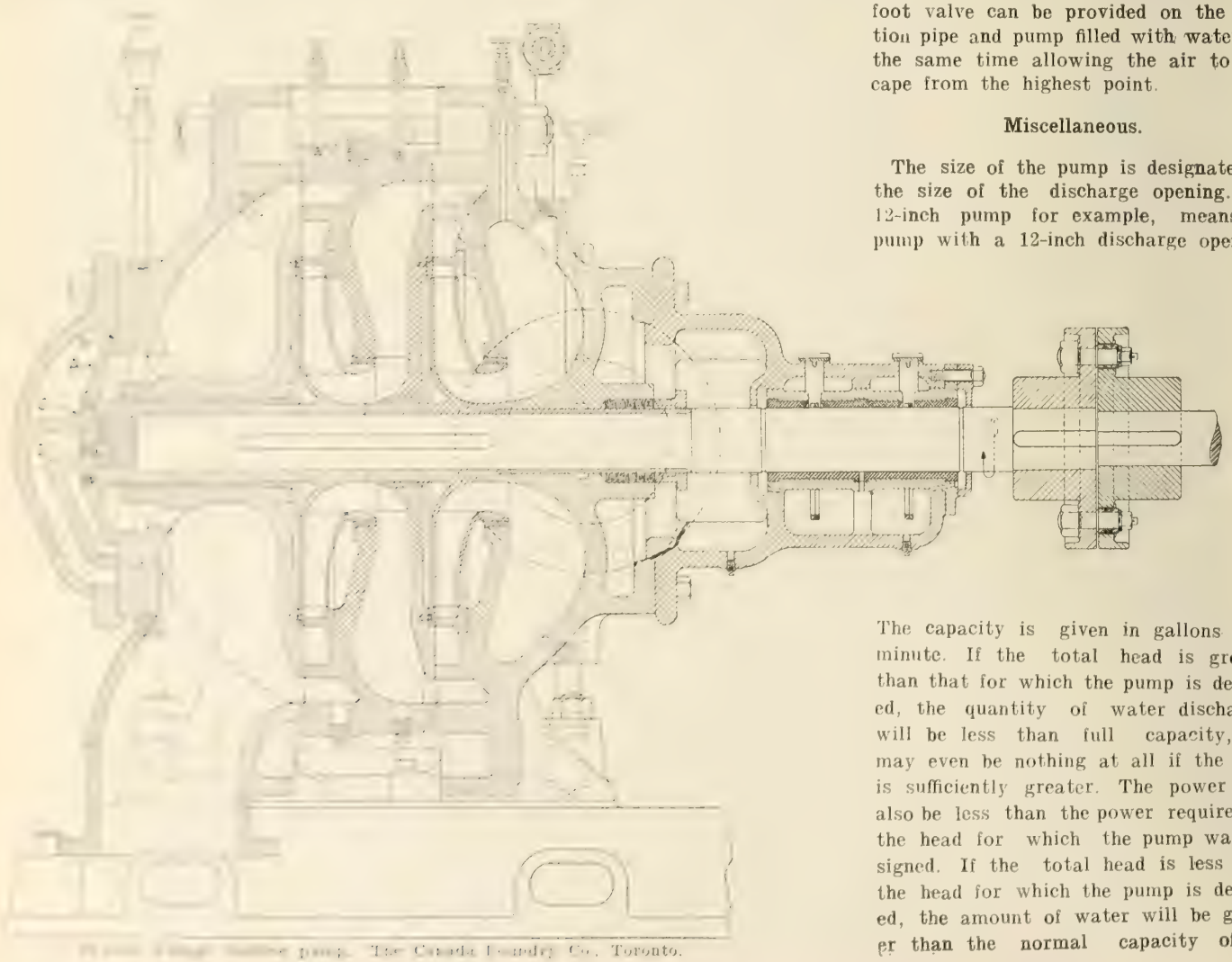
The head against which the pump operates is understood as the distance in feet between the level of the water in the suction well and the level in the discharge tank. It is not understood as the distance from the centre line of the pump to the water in the discharge tank only, without including the suction lift. Account must also be taken of the friction of the water in the suction and discharge pipes, and this must be added to the measured head in order to give the actual head against which the pump is working. Should these pipes be small in relation to the amount of water passing through them, this friction head may be very large in relation to the actual head,and should on no account be left out in making calculations for a pump.

Instructions for Operating.

Massive foundations are not necessary; but the pump should be so placed that perfect alignment is assured. The suction line must be free from air leaks and if more than twenty feet in length, it should be larger than the pump suction to avoid undue friction. The discharge line must be of sufficient size to remove the water without excessive friction loss. A gate valve should be located in the discharge near the pump. Before starting, it is necessary to fill the casing and suction line with the fluid to be pumped, as machines of this type will not create a vacuum of any moment without first being primed. The pump must always be primed therefore before starting. Otherwise there is liability of injuring some of the interior operating parts which depend upon water being present for lubrication. Priming is accomplished either by closing the discharge gate or check valve, and exhausting the air from the pump by means of an ejector or air pump, thus allowing the water to flow in from the suction well; or a foot valve can be provided on the suction pipe and pump filled with water, at the same time allowing the air to escape from the highest point.

Miscellaneous.

The size of the pump is designated by the size of the discharge opening. A 12-inch pump for example, means a pump with a 12-inch discharge opening.



The capacity is given in gallons per minute. If the total head is greater than that for which the pump is designed, the quantity of water discharged will be less than full capacity, and may even be nothing at all if the head is sufficiently greater. The power will also be less than the power required for the head for which the pump was designed. If the total head is less than the head for which the pump is designed, the amount of water will be greater than the normal capacity of the

pump, and the power consumed will also be greater.

The pumps can always be run on reduced heads by throttling the discharge until the desired quantity of water is obtained. This creates an artificial head and reduces the efficiency of pumping, but will prevent overloading the motor. When the pumps are in operation the only attention they require is an occasional inspection of the oil in the bearings and the packing in the stuffing boxes

HIGH LIFT TURBINE PUMP.

The high lift turbine pump described and illustrated herewith, was built for the Corporation of the City of Winnipeg, Man., by the Canada Foundry Co., Toronto. It is of the C. F. Co.'s latest 2-stage type, with a 12-inch suction and 10-inch discharge, and is direct-connected to a 200 B.H.P. variable speed, 2,-200 volt, induction motor, supplied by the Canadian General Electric Co., Peterborough. The guaranteed duty is 1750 Imperial gallons per minute, against a pressure of 125 pounds per sq. inch, when running at 900 r.p.m.

End Thrust Balancing.

One of the special features of the pump is the method of balancing the end thrust. A special balancing valve shown at A, is screwed on to the shaft and revolves with it. At the joint B, a clearance of .001 inches is provided between the faces, and at joint C, a clearance of .004 inches is also provided. On starting the pump, the rising pressure forces the balance valve A over, until the clearance of joint C has disappeared, and the leakage of water at joint B gets entrapped in the casing or cover of valve A This entrapped water rises in pressure until it is sufficiently high to push the balance valve A to the right, on doing which, part of the water in the casing escapes back to the suction side of the pump, by way of the passage D, in the centre of the casing. Equalization of pressure is thereby obtained on both sides of the balance valve, consequently the latter assumes an intermediate position between the faces, and remains so while the pump is in operation

Construction Details.

As will be noted from the illustration, the pump is strongly built, and embodies the latest improvements necessary to high efficiency operation. Each pump casing is of cast iron, and is a one-piece casting. The impellers and diffusion rings are also of cast iron, while the shaft is of best machinery steel. The bearings are ring-oiled, and the shaft stuffing boxes water-sealed.

STEEL PIPES FOR WATER MAINS.

At a meeting of the Birmingham (England) Association of Mechanical Engineers, held recently, a paper was read on welded steel pipes for water mains. The following is a synopsis of this paper: "The most important requirement of a pipe is reliability, by which is meant not merely that the pipe must be strong, but that the engineer should have a reasonably good idea of just how strong it is. Mild steel pipes are at once the strongest and most reliable, and are gradually but surely taking the place of cast iron, not only for water but for sewage and gas mains. Another advantage which the lapwelded steel pipe claimed over cast iron was its increased carrying capacity, the smoothness of the bore, reducing the friction, known as 'skin friction,' between the fluid and the surface of the pipe. This is an important point frequently overlooked or often underrated, but seeing that the capacity of a pipe of a given bore may be more than doubled by substituting a smooth for a rough interior surface, it would be understood that it is a matter worth careful consideration. The smoother rolled surface of the lapwelded pipe took an excellent coating or protective solution having a hard glossy surface. Added to this the pipe was a smooth cylinder from end to end, as there was a complete absence of anything in the nature of rivets, butt straps or lapped plates. In consequence, the frictional resistance was less, and the velocity and carrying capacity greater with lapwelded than with any other form of pipe. The question of the life of steel pipes had long been the subject of much conjecture, owing to the fact that there was no data on which to base a rule. All that could be said was that the oldest and best known steel pipe lines were as far as could be ascertained, in as good condition and as free from corrosion now as when they were laid."

WATER POWER IN JAPAN.

That the Japanese are becoming very active in developing the various water powers of their country was the statement made by Mr. Takahashi, C. E., who is in Canada looking over the many power plants completed and under way.

Mr. Takahashi is engaged on a formidable power proposition about 150 miles from their capital city of Tokio, and has been spending the last two months in the United States, Ontario and Quebec. While he is convinced that the Dominion offers all he wants to see as an engineer, he will carry out his mission and proceed to Norway, Sweden, and other European countries where water powers abound.

The city of Tokio, he says, is now supplied by two water plants of 67,000 horse power and four steam plants aggregating about 40,000 additional horse power, but when the new plant on which he is engaged is completed, a good part of the present steam plant will be done away with.

W. KENNEDY & SONS, LIMITED, OWEN SOUND.

This firm established away back in the year 1860, has, in addition to a wide connection throughout the Dominion for the sale of large and small steel castings of its own manufacture, also a leading place in the water turbine field, as the following record amply shows.

Among contracts on hand and recently completed, are one 2,000 h.p. unit turbine for the Bronson Co., Ottawa, to run at 220 r.p.m., on 33 feet head; one pair horizontal Francis turbines, 450 h.p., 250 r.p.m., 23 ft. head, with inward discharge, also 40 h.p. exciter turbine, 600 r.p.m., for the Minnedosa Power Co., Minnedosa, Man.; one pair Francis turbines, 265 h.p., 400 r.p.m., 25 ft. head for the Durham Furniture Co., Durham; one pair Francis turbines, 1,800 h.p., 257 r.p.m., 43 ft. head, with exciter turbine, 100 h.p., 600 r.p.m., for the Wanipitae Power Co., Sudbury, Ont.; one single vertical Francis turbine, 1,350 h.p., 150 r.p.m., 32½ feet head, for the Cobalt Power Co., Cobalt, Ont. Oil pressure governors of latest European design are furnished with all water wheel equipments

Stiff Leg Stop Log Winches.

Stiff-leg stop log winches are another speciality of the firm. Only recently completed, are two sets of 27 tons capacity each, for the Dominion Government, and Corporation of Renfrew, Ont., respectively. These winches are arranged for both a side and end movement, so as to pile up the logs, back on the dam. They have also a contract on hand for one of 17 tons, to the order of the City of Winnipeg, Man. All winches are of the connected carriage type.

An order for 3 rock cement or coal pulverizers of 17 tons weight each, have been completed and shipped to the Canada Cement Co., Works, Montreal.

Engineering Department.

Mr. T. Dowsley Kennedy, the responsible head of the engineering department, is a graduate of the University of Berlin, Germany, having taken the full engineering course of 4½ years. He studied also in Switzerland, and other industrial centres on the continent of Europe, besides being works engineer with the J. M. Voith Co., Heidenheim, Germany.

Power Plant Troubles, Happenings and Improvements

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

THE CHEMISTRY OF COMBUSTION.

By J. W. Hayward, M.Sc.

IT is usual to speak of the coal alone being consumed in a boiler furnace, but it would be just as correct to speak of the air passing through, as the fuel burnt. In fact it would express better what happens, since twelve pounds of the latter are used up for each pound of the former. This air measures 13 cubic

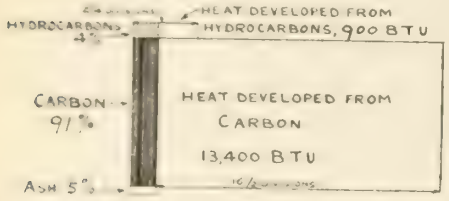


Fig. 1—Anthracite.

feet at 60 degs., and at 2,000 degs., the temperature of the fire, it measures 62 cubic feet. It requires two substances to make combustion, just as two persons are necessary to a quarrel.

Essentials for Combustion.

The essentials for combustion are, that the individual particles of the substances to be united, shall come into actual contact with one another, when at a temperature sufficiently high to cause their union. With gaseous mixtures, the particles intermingle naturally, but it is impossible to mix air so thoroughly with a solid like coal that the latter may be fully consumed. In the best practice an excess of 100 per cent. of air, and in bad practice, much more, finds its way past the fire, unconsumed. This costs nothing, it is true, but since it reaches the chimney some four hundred degrees hotter than it enters the ashpit, it carries off with it heat that would otherwise be available for steam raising.

The particles of air round a lump of coal, may be compared to pigs round a trough. Some get a full feed, some get a bite, while some are crowded out and get nothing. Air is a mixture of two gases, oxygen and nitrogen, in the ratio of 23 pounds of the former to 77 of the latter. The nitrogen takes no part in the combustion; in passing through the fire, it is heated; in passing through or around the boiler tubes, it is cooled, although not to its original temperature; consequently it carries heat up the chimney. The oxygen alone enters into combination.

Coal is not, like air, a substance of uniform composition. It is a mixture in varying proportions, of carbon, of compounds of carbon and hydrogen called hydrocarbons, of some incombustible matter forming ash and clinker, and two or three per cent. of moisture.

The accompanying table gives the compositions of a high grade Pennsylvania anthracite, and of a low grade soft coal from Nova Scotia, after the moisture has been dried out of each. Most steam coals lie between these limits.

	Pennsylvania anthracite	Nova Scotia soft coal
Volatile hydrocarbons	4 p.c.	37 p.c.
Carbon	91 p.c.	48 p.c.
Ash	5 p.c.	15 p.c.
	100 p.c.	100 p.c.
Heating value B.T.U.	14,300	11,500

From the heating values it is apparent, that for every dollar asked for the poor coal, it would be advantageous to pay up to a dollar and a quarter for the anthracite.

Process of Combustion

During combustion, the carbon combines with the oxygen of the air in the ratio of one pound to two and two-thirds, forming carbon dioxide gas. For each pound of carbon burnt, heat to the extent of 14,500 thermal units, or enough to evaporate 12½ pounds of water under normal condition, is generated. The particles of carbon have unfortunately a way of satisfying themselves with only half the above proportion of oxygen, if the supply is meagre. The product is then carbon monoxide gas, and only 4,450 thermal units are generated. Carbon monoxide will itself burn to carbon dioxide, generating the balance of the 14,500 thermal units, if it meets with fresh oxygen, when it is still at a high temperature. It burns with the blue flame often seen above a clear fire.

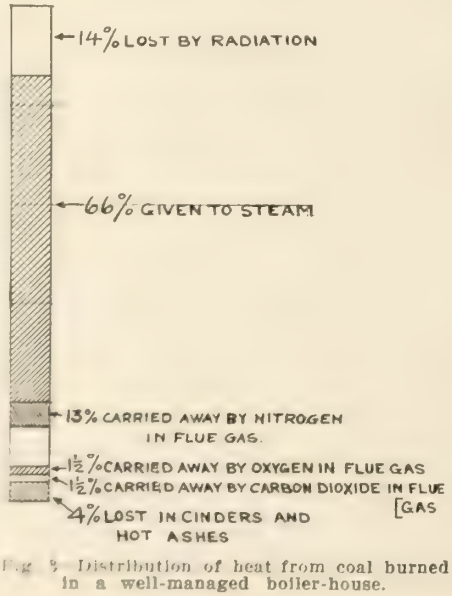

14% LOST BY RADIATION
66% GIVEN TO STEAM
13% CARRIED AWAY BY NITROGEN IN FLUE GAS.
1½% CARRIED AWAY BY OXYGEN IN FLUE GAS
1½% CARRIED AWAY BY CARBON DIOXIDE IN FLUE GAS
4% LOST IN CINDERS AND HOT ASHES

Fig. 3—Distribution of heat from coal burned in a well-managed boiler-house.

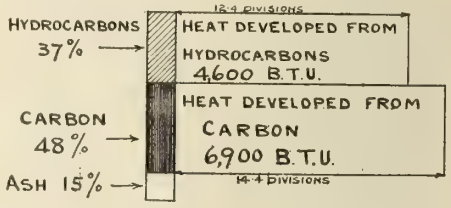


Fig. 2—Soft Coal.

The presence of unburnt carbon monoxide in the chimney, can only be determined by chemical analysis of the flue gases. Experience teaches that it begins to appear when less than 20 pounds of air is admitted to the furnace, per pound of coal. Combustion of the carbon takes place upon the fire bars. The heat generated is in part transmitted to the boiler plates and tubes by direct radiation, where these are exposed to the fire; in part, it is also given to the carbon dioxide and air, which in their turn, give it up to any surface cooler than themselves and over which they pass. The hydrocarbons are largely evaporated by the heat of the fire, and readily split up into carbon and hydrogen. The union of carbon with oxygen has already been discussed. Hydrogen combines with oxygen in the proportion of one pound to eight to form steam, 51,700 thermal units being generated for each pound consumed. The hydrocarbons burn in the combustion space above the fire, the reaction being indicated by flames. If the temperature of these burning gases is lowered by striking the comparatively cool surface of the boiler, the reaction will be checked, and the carbon of the hydrocarbons will pass on unconsumed as smoke. Smoke will also result if insufficient air is supplied.

The Smoke Nuisance.

The smoke nuisance is then due to one or both of the above causes, and can be cured by removing them. A large space above the fire will give the hydrocarbons opportunity to burn completely, and a separate supply of air to this space provides the oxygen re-

quired to complete the combustion of them. The amount of air just necessary to prevent smoke, must be determined by experience, and no more should be admitted; otherwise the attempt at smoke prevention will lead to a waste, instead of a saving, of heat and fuel.

The incombustible matter in coal gives trouble in proportion to its quality, rather than its quantity. If infusible, it merely forms a fine ash, which readily drops between the fire bars. If, on the other hand, it melts at the fire temperature, it spreads out as a thin sheet of clinker, and stops the supply of air to the fresh coal above it. Trouble with clinker is reduced by any contrivance which will cool the under side of the fire, and congeal the fused ashed before they run into sheets. A common expedient is to blow steam into the ashpit. The oxygen in steam has a greater affinity for the free carbon it finds in the fire than for the hydrogen with which it is already united. It consequently turns off the one to unite with the other, forming carbon dioxide and carbon monoxide. This reaction absorbs much heat, and so cools the fire. A similar scheme is employed in gas producers to reduce the waste of heat. Above the fire, air is supplied to reburn the hydrogen formed, and to complete the combustion of the carbon. The heat taken from the bottom of the fire is regenerated in the combustion chamber. If waste steam is used, no loss of efficiency need occur.

TEST OF 5,000 K.W. TURBO-ALTERNATOR.

In a previous issue we referred to and gave particulars of the test of a 3,000 k.w. steam turbo-alternator supplied to the corporation of Bristol, England, by the British Westinghouse Electric and Mfg. Co. We are now in receipt of the test data of a 5,000 k.w. unit, supplied by the same company to the Clyde Valley Electrical Power Co., and installed in their Motherwell Power House. The results are even better than those got from the Bristol unit, and we are glad to have the opportunity of publishing them for comparison.

The turbines are of Westinghouse latest improved impulse type arranged for running 1,500 r.p.m., with steam at 175 lbs. per square inch and 150 deg. F. superheat, both being measured at the stop valve.

The conditions specified for carrying out the tests were as follows:—Normal output 5,000 k.w. 3-phase, 25~11,000 volts, 25 per cent. over-load for six hours, full load for six hours, three-quarters full-load for two hours, one-half load for two hours, one quarter load for two hours.

The tests work out as follows:

Output kw...	1346	2715	3902	5066	6487.5
Steam pressure lbs... ...	174	176	175	174.5	174.5
Steam temperature deg. F.	518	519	542	552	544
Steam superheat deg F...	141	141	164	175	167
Vacuum corrected to 30-in. bar	28.13	28.28	28.58	28.68	28.53
Circulating water inlet deg. F....	43.9	43.7	44	44	43
Circulating water outlet deg. F	48	52.6	57	60	65.5
Steam consumption total lbs...	24780	40130	53125	65860	85880
Steam consumption, lbs. per kelvin	18.41	14.78	13.61	13.00	13.24

COMBINED STEAM AND GAS ENGINES.

This extract treats of utilizing the waste heat from the gas engine exhaust, by generating steam in specially designed exhaust boilers, and formed part of a paper read by Alan E. L. Chorlton at a recent meeting of the Manchester Association of Engineers.

Mr. Chorlton is an expert on gas engine design, construction and operation, particularly for large units, and what he has to say is therefore of considerable importance.

Waste Heat Utilization.

The utilization of the waste heat from the gas engine must appeal to all engineers as a proposition of considerable commercial value. Despite, however, the general knowledge of the amount of heat lost in the exhaust and jackets, not much progress has been made in utilizing it, for although there are a number of exhaust boilers at work, they represent a very small proportion of the gas power in use.

The main conditions to be fulfilled in an exhaust boiler are: First, that it be fixed as near to the engine cylinder as possible, otherwise the evaporation will be low and not justify the first cost; second, that it be made and maintained absolutely water-tight, as any leakage means rapid corrosion from the surphuric acid formed from the exhaust gas (to meet this capped ferrules are sometimes used at the tube ends); and third, that for the same reason, the reduction of the temperature of the exhaust gas must not be carried too low.

Usually there is one boiler per cylinder, but an efficient installation is obtained at reduced cost by passing the exhaust gas from a twin-cylinder engine with cranks at 90 degrees through one boiler shell situated in close proximity to the engine cylinders. This arrangement gives practically a continuous flow and obviates any loss due to an intermittent action. Economizer pipes, which it is often advisable to fit to preheat the feed, are best made in cast iron.

The evaporation of an exhaust boiler as usually arranged may reach 3 pounds per trade horse power, and by special means this can be increased. The boiler sizes vary more or less with different conditions, but an average area through the flue in square inches is .8 of the cylinder capacity in trade horse power, with a length from 6 to 7 feet 6 inches between tube plates. In all cases the boiler should be as long as possible.

COAL FUEL INTERNAL COMBUSTION ENGINE.

In an experimental engine recently built and tested by A. M. Low, London, England, a number of parallel pipes pass through a chamber heated by the exhaust gases and also through the back of the combustion chamber. Powdered coal is pushed by a screw feed through these heated pipes, and the gas given off passes into a small gas holder in which the pipes terminate under a water seal. The gas is drawn into the cylinder by suction. The inventor claims that on short continuous runs he has been able to obtain one brake horsepower-hour on a consumption of less than 0.4 lb. of coal.

Compressed air works like a charm for cleaning boiler tubes, leaving them as clean as on the day they were put in. This is the verdict of a correspondent of the Engineer, who had formerly used steam hose for this purpose, but upon the installation in the plant of a large air compressor for pumping water, tried the compressed air method. The air pressure was about 200 lb. per sq. in., and the rest of the apparatus consisted of a $\frac{3}{4}$-in. hose with a straight piece of $\frac{3}{4}$ in. pipe for the nozzle.

Dip your knife in water before cutting rubber gaskets. You will make a better job, and the knife will keep its edge longer. A little soda and water or potash and water will be better better still, if obtainable.

REFRIGERATION DEPARTMENT

THE PRINCIPLE OF REFRIGERATION.

By W. G. Walters, Stratford.

VERY few appreciate the fact that the cooling or heat abstracting process employed in industrial refrigeration is nothing more or less than an evaporating process based upon the principle that the conversion of a liquid from its fluid to its gaseous state, can only be accomplished by the application of heat. While the uninitiated may not have a definite conception of the physical actions attending such conversions, yet there are few who would express wonder or surprise concerning the common and extended practice of this principle as applied to a steam boiler.

Steam Evaporation Comparison.

The conversion of water into steam through the transmission of fire heat to the water, is a principle too generally understood to permit discussion. If, however, we descend to degrees of temperature, which in every day language are designated as cold, or lower degrees of heat, the principle involved apparently assumes a different aspect, yet without consideration of the qualities of the liquid employed in evaporation, there is no material difference whatever in the causes which convert liquid anhydrous ammonia or water from their liquid into their gaseous state, and no difference in the effect produced by such conversion.

The same principles which govern the change of water into steam under various pressures, apply equally to the conversion of anhydrous ammonia from a liquid to a gaseous state. If we are to thoroughly understand the principle of refrigeration, it is necessary to know something about heat. Hot and cold are relative terms. For illustration, suppose we have a room at zero temperature, while another is 15 degrees [illegible] desired to have both of them at the lower temperature, that at 15 degrees above is too hot, although correctly speaking it would be called a cold room.

It is also necessary to get a clear conception as to the meaning of latent heat. Suppose feed water comes from the heater at a temperature of 200 degrees F., it will require 12 heat units to raise one pound of it to the boiling point. To change this 1 lb. of water into steam without raising the temperature, there are required 966 heats units more, and in order to condense the steam to water again, these 966 heat units must be abstracted.

Let us take for illustration the case of an engineer in a plant, who has a room over the boilers. The heat rising from the latter keeps this room at a temperature of 250 degrees F. If used as a dry room that requires only 220 degrees, we have a room that is too hot for its purpose, and the question is, how to reduce the temperature to that required. One method would be to place coils of pipes in the room and circulate cold water through them. Part of this water will be evaporated into steam, and in so doing will absorb 966 heat units for each pound of water evaporated. If we employed a condenser to change the steam back to water again, by abstracting the 966 heat units from each pound, and installed an apparatus for circulating the steam between the dry room and the condenser, the water would change its state continually, taking up heat in the dry room and losing it to the condenser.

Refrigeration.

In a refrigerating plant the conditions are very much the same, only instead of water, anhydrous ammonia is used, and instead of reducing the temperature to 220 degs., it is reduced below zero. To get an idea how this works out in an ammonia plant, let us suppose that water is admitted into the dry room slowly. Under this condition the small amount of water admitted into the coils will flash into steam immediately. To keep the room at 220 degrees the pressure in the coils must be kept at 3 lbs. See steam tables. To keep the pressure at 3 lbs., it is necessary to use a compressor, and which is simply a pump having little clearance. By connecting the suction of the compressor to the coils, the steam and water can be pumped out as fast as necessary, to keep the pressure down. Assume the steam to be compressed to 150 lbs.; the temperature corresponding being 366 degrees. The steam goes to the condenser at this temperature and pressure, and by passing cold water over the coils, the latent heat is removed, so that it is condensed into water. If the supply of water flowing over the condenser coils is sufficient and of a low enough temperature, we can further abstract the heat down to that of the condenser water. From the condenser the water passes again to the coils and repeats the performance as outlined above. By a little consideration, the method of using ammonia in the same way, is at once seen.

Water boils at a temperature of 212 degrees under atmospheric pressure, while ammonia at the same pressure boils at 30 degrees below zero. With water, 3 lbs. back pressure gives a temperature for the dry room of 220 degrees, while an ammonia system would work at say 20 lbs. back pressure, and reduce the temperature of the same room to 5 degrees above zero. At 150 lbs. pressure, the temperature of the steam is 366 degs. With an ammonia system, the temperature would be about the same as the cooling water, (which in good installations is about 62 degrees) and the pressure would be from 130 to 150 lbs. In changing from water to steam, the water absorbs 966 heat units per lb., while ammonia in changing from liquid to a gas absorbs 572 heat units. It can be readily seen that water and ammonia correspond in a good many ways and a good understanding of the laws of heat and cold, can be drawn from the principle of the steam plant.

ICE FACTORY ECONOMIES.*

By W. E. Siddons.

HIGH efficiency depends upon perfect installation, excellent natural conditions and careful management. High cost of production is more directly chargeable to poor installation, perhaps, than any other cause. Unfavorable natural conditions and careless management contribute, in a large measure, to unsatisfactory results, and the three combined will make any owner a candidate for an insane hospital. Careful management will do much to overcome the mistakes of installation, but unfavorable natural conditions are an almost insurmountable obstacle to low cost of production.

* Paper read before the Indiana Ice Dealers' Association, March, 1911.

The erecting engineer draws his salary for his capabilities, and it is up to him to make the necessary showing for the test run and so secure your acceptance of the plant.

This test is made under conditions that are wholly favorable to a successful outcome, as everything is new. No scale on the steam or ammonia condensers, flues and shell plates of the boiler new and clean, therefore everything works right up to the promised capacity, under the watchful care of the experienced engineer. You are delighted with everything; your acceptance is given and your engineer takes charge. Then your troubles begin. Your boiler, your ammonia and steam condensers start to lay in a good supply of hard scale, and various other things begin to happen, until about the third season you begin to realize how little you knew about an ice plant. Most of you have had the experience, and it is not necessary for me to say anything further, than that a plant should never be installed, except under the eye of a competent consulting engineer who is receiving your pay for his services.

From Natural Gas to Coal.

I will venture the assertion that ninety per cent. of the mistakes of installation, bad natural conditions and poor management find its way back to the coal pile. You who have never operated a plant on natural gas at a price so low as to be almost a joke, cannot appreciate the troubles of those who had this advantage for a time, and who, when gas was exhausted, had to begin using coal. The writer was one of those poor unfortunates, and when we had to go from gas to coal, we began to learn our lesson; yet I do not know but that it was an excellent experience. Fuel was a matter of no moment while we had the gas, but when we began using a fuel we had to pay for at a high price, pay a high freight rate to get it to us, provide bins for its reception, pay for its unloading, also ofttimes demurrage charges, and sometimes have to shut down our plant for lack of it, we began to sit up and take notice.

Correcting Mistakes of Installation.

It was then we started in to correct the mistakes made in the installation of our plant. We actually ran a 35 horsepower straight line air compressor on a flowing well for three years, but when we began to burn coal that air compressor lasted about as long as a June frost. We found that our auxiliaries were of the cheapest type, and eventually replaced every one of them with good ones. The mistake we could not correct was in the tank. When the plant was contracted, the can allowance was but tens cans to the ton, and we found that the machine was amply large to care for an allowance of fourteen to the ton. Another error we could not rectify was the placing of the tank, the foundation of which was put on the ground. The tank should have gone up and storage room been put under it, thus doing away with the building and insulating of an ante and storage room, to say nothing of the brine pump and circulating coils, and the cost of operating a brine pump while the plant lasts. I merely cite these instances to give you an idea of the cost of mistakes of installation.

The diminishing coal pile and how to conserve it, is one of the many causes of gray hair and early decay. Steam plants are individuals and should be treated as such. The requirements of one may be totally different from those of its exact duplicate. One plant may be operated on one kind of coal with complete success, while the other would fail to show at all satisfactory results, using the same coal. You must therefore study the requirements of your plant, with the aim to secure that which gives the best results. A boiler should never be set except under the watchful eye of an expert, and no effort or expense should be spared to make the setting as perfect as material and workmanship will make it. A boiler of the larger type should not be set closer than 48 inches from the top of the grate bars. This prevents the blaze from coming into direct contact with the shell, and will add materially to the life of the boiler, in addition to providing better space for air mixture with the released coal gas.

OUR ADDRESS.

Many visitors to Toronto intending to call upon The Power House take the most convenient method of getting our exact address — the telephone directory. Through an oversight on the part of the Telephone Company, the latest directory gives the wrong number — 111 *University Street. The street was recently renumbered, and the entrance to our office is now* 143 *University Avenue, just the centre of the next block north of the number given in the telephone directory.*

Economy in Boiler Room.

I am not an advocate of the stoker on small plants, for I think that shovel firing cannot be excelled by any device, if proper care is exercised. If you have a large battery of boilers, one man using stokers is often sufficient to care for all of them, and a saving of labor is thus effected, but in the small plant I consider the rocker and dump grate and hand firing equal to stokers. Your plant should not be operated with a single square foot of grate surface in excess of what you actually require. If I remember correctly, for every square foot of grate surface in excess of your actual requirement, you will burn 12 pounds of coal per hour. If this is true, one extra square foot of surface will cost you 288 pounds of coal in 24 hours. At the end of the season's run, could you see the coal thus unnecessarily burned, all in one pile, you would be astounded.

There are many devices on the market for boiler economy, and among them is the rear end flue blower, of which there are several types, and all of which are more or less successful. They are a great improvement over the old way, as they blow with the draft and carry the soot up and out of the stack.

Feed Water Heating.

Feed water should go to the boiler at not less than 210 degrees, and it is well to put a thermometer in your feed water often. We always used the closed type heater until last year, with fairly good results when kept clean; but this heater went bad on us, and we had an opportunity to buy a used Stillwell heater of the open type, at a low cost. We installed this heater, partly as an experiment, and have had excellent results. The water goes to the boiler at 210 degrees, and we have not had the least trouble.

Your boilers should be equipped so that you can feed through the blowoff as well as through the top feed, so that in the event of a clogged blowoff, you can put your pump pressure against the obstruction and remove it. I think it advisable to install an auxiliary feed pump or injector, for if anything goes wrong with your feed pump, and you have but the one way of feeding, you have an expensive shut down of the entire plant. This is not so necessary where you have a water softener in service, but it is a precautionary measure that will often prove its worth. Wherever there is a tendency to scale deposit, a water softening plant will pay for itself many times over in the saving effected by reason of clean shell and tubes of boilers, replacing feed water lines and boiler flues, pump repairs and shutting down the plant to remove accumulated scale. You all know what heavy scale on the boilers will do to the coal pile, and I think the water softener has completely solved this vexatious problem.

All steam lines should be covered with a good pipe covering, and all exhaust lines should be equipped with valves, so as to enable you to pack a gland or take off a steam cylinder head for a quick repair, without shutting the steam off the entire plant. You will find that it will pay you to take every precaution to prevent your plant being shut down during the season. For of all things to be avoided, it is to shut down when there is a demand for every pound of your product. I think it well to duplicate your auxiliaries throughout the plant so that when one goes wrong you have the other to fall back on. Everything should be of ample capacity to take care of your requirements at a time when you are calling for every pound you can turn out.

Care in Selection of Supplies.

Oil is cheaper than metal, and the difference of a few cents per gallon in the cost of oil is a mighty small matter when you take into consideration that a poorly lubricated bearing means increased friction, and increased friction means increased energy, and increased energy means more coal. Many plants have arranged to catch all waste oil, piping it to a catch basin and putting it through an oil filter. With the addition of a small amount of fresh oil, it can be used over and over again. Great care should be exercised in the selection of your packing, for here you have another friction problem. I have seen rods so badly scored and worn that they were only half their original diameter, and all caused by a poor grade of packing or a too zealous engineer. You need not be told that steam leaks never become smaller and should have instant attention. To generate steam costs money, and its wilful waste is the surest sign of bad management.

Ice-Making Machinery.

I have often heard opinions to the effect that brine solution should be as nearly a saturated solution as possible, but I have always held the brine at just such density as would keep frost off the coils. It agitates better when not so heavy as to be sluggish, and you will obtain as good results. Do not overlook the importance of good agitation. Through it you obtain an equal distribution of the temperature over the tank; and when the brine lying next to the can becomes loaded with heat from the water, it should be moved away to make room for other brine ready for its load of heat.

Proper attention should be given uniform filling of cans, as you do not get any more for long cakes than you do for shorter ones. Another essential feature is the temperature of your storage room. Your finished product is taken care of there until marketed, and it is economy to have sufficient circulation to keep your temperature below the freezing point.

Always bear in mind that you cannot make ice without ammonia. Keep your charge at all times up to its highest point of efficiency. It is no use pumping air through your coils; give them all the ammonia they will take consistent with the capacity of your receiver.

Lastly, never let an opportunity pass to attend a convention of your association. The various associations throughout the country have done more to put the ice industry on a paying basis than any other one thing. Lend your every effort to the advancement and growth of your association. Cultivation is the natural road to advancement and growth and it applies as well to business as it does to gardening.

The Canadian Electrical Assocation Annual Convention

Being a Condensed Account of a Most Successful Convention Held at Niagara Falls, Ont. Increased Interest was Noted in the Proceedings, Particularly as Regards Reading of Papers and Attendance; Warranting the President's Remark that Affiliation With the National Electric Light Association was Largely Responsible for the Improvement Shown.

The 21st annual convention of the Canadian Electrical Association was held at Niagara Falls, Ont., on June 21, 22 and 23. The convention headquarters was the Clifton Hotel. A very large representation of members of the association registered, particularly on Thursday, which was Coronation Day. The various papers read were of a high order, evincing much care and study, and at the same time thorough familiarity with each subject by its author. Publication will be made of several of the papers read in succeeding numbers of The Power House.

The social side of the convention formed a pleasing feature after the business routine of each day, while the ladies, of whom there were a large number present, were specially cared for in the matter of automobile rides, boat trips under the Falls, etc. Through the courtesy of the officials of the various hydraulic power plants located near the Falls, large numbers of the delegates took advantage of being shown through.

Much of the success of the convention was due to the efforts of the local committee, of whom special mention may be made of Mr. W. L. Adams, the Ontario Power Co., Niagara Falls. To Mr. T. S. Young, Toronto, general secretary, of the association much credit is also due for the careful and complete arrangements made for the conduct of the convention business.

On this page will be found a group picture of representatives and guests taken in the hotel quadrangle on the morning of the closing day.

Convention Opening.

The president, Mr. A. A. Dion, of the Ottawa Electric Co., after declaring the

GROUP PICTURE OF DELEGATES AND GUESTS.
The Canadian Electrical Association Convention, Niagara Falls, Ont., June, 1911.

convention open for business, introduced Mr. O. W. Dores, Mayor of Niagara Falls, Ont., who, in welcoming the Canadian Electrical Association, said that among the many conventions which come to their city during each year, none had given him more pleasure to welcome than this body of electrical men now gathered. He further extended the freedom of the city to each and all with the additional rider that petty misdemeanors and keeping of late hours would be carefully unnoticed by the police.

The president in reply thanked the Mayor for his words of welcome and prospective police favors, and expressed the belief that the record of the Canadian Electrical Association for good citizenship behaviour was more than likely to be maintained.

The president's address and sec'y-treasurer's report followed, the latter being unanimously adopted. Mr. J. J. Wright, of the Toronto Electric Light Co., was, on the recommendation of the managing committee, elected a life member of the association. Corespondence and general business next occupied the attention of the members, after which a paper entitled "Operating Safeguards" was read and discussed. Mr. E. Little, Fort William, the author of the paper, was not present, and Mr. Pack read in his stead. A paper by Mr. Glenn Marston, Chicago, entitled "The Advantages of Publicity to the Central Station Industry," took up with its reading and discussion the remainder of the morning session.

At the afternoon session, papers were read by George R. Smith, of the New York Edison Co., on "Service Protection"; by C. E. Bowden, of the Toronto Electric Light Co., on "General Accounting"; and by the chairman of the committee on "Uniform Accounting." A ball game between teams representative of the manufacturers and central stations followed this business session's adjournment.

Thursday, June 22nd.

At the morning and only business session, papers were read by Willis McLachlan of the Trenton Electric and Water Co., entitled "Some Notes on Central Station Management"; by B. G. McNabb, of the Montreal Light, Heat and Power Co., entitled "Relations of Public Utility Corporations With the Public"; by Parker H. Kemble, of the Toronto Electric Light Co., entitled "Some Notes on Business Getting"; by Mr. Lamb, entitled "An Explanation of the Canadian System of Government Control of Electric Light and Power Service"; by Mr. Ravies, Montreal, entitled "Metering Under Two Rates, as Practised in Montreal"; by H. S. Baker, Niagara Falls, entitled "Testing for Errors in Polyphase Meter Connections"; and by Ralph Beman, of the National Electric Lamp Association, of Cleveland, entitled "The Incandescent Lamp and Its Circuit."

Mr. Gilchrist, president of the National Eelectric Light Association, addressed the morning session of the convention, while Mr. Munro Grier of the Canadian Niagara Power Company, and Mr. Samuel Insull, president of the Commonwealth Edison Co., Chicago, contributed appropriate after dinner speeches in connection with a specially arranged Coronation Day luncheon.

Aquatic sports at Chippewa formed the recreative programme during the afternoon, special cars being provided to take the members to and from that township.

Friday, June 23rd.

An executive session constituted the opening business of the convention, and at which the following officers were elected for the ensuing year:

President—A. A. Dion, the Ottawa Electric Co; vice-president—R. F. Pack, the Toronto Electric Light Co; 2nd vice-president—W. L. Adams, The Ontario Power Co; 3rd vice-president—W. L. Bird; secy-treasurer—T. S. Young Toronto.

Members of Executive—W. L. Hawkins, A. L. Mudge, C. E. A. Carr, D. H. McDougall, F. A. Chisholm, L. V. Webber, W. Phillips, J. H. Larmouth, J. S. Norris, I. H. Wright, J. W. Pursell, R. H. Sperling, J. W. Crosby and R. B. McDonagh. The honorarium to the secretary was increased to $500 as a mark of the high appreciation in which Mr. Young's services are held.

Papers read at the open sessions of this the closing day of the convention, were as follows:

"The Importance of Co-operation Between the Central Station and the Manufacturer," by Chas. F. Scott. "Ornamental Street Lighting," by T. H. Kelly, of the Hamilton Electric Light and Power Co.; "The Importance of the Use of Potential Regulations on Distributing Systems," by C. E. Allen, of the Westinghouse Electric & Mfg. Co., Pittsburg; "Electric Heating and Cooking Devices," by R. J. Parke. The report of the committee on "Standardization Line Construction" was submitted by Mr. R. G. Black, and that of the Commercial Committee by Mr. Pursell.

Votes of thanks to all who had worked for the success of the convention were unanimously adopted and arrangements made whereby the management committee are empowered to settle the location and date of next year's convention, as well as transact any unfinished business arising out of the present meeting.

Evidences point to Ottawa as being the next convention city.

Convention Souvenirs.

Convention souvenirs in the shape of steel pocket rules in leather cases and silver pencil holders were distributed amongst the members and lady guests at the convention by Mr. Geo. F. Haworth, Toronto, of Sadler & Haworth, belting manufacturers, Toronto and Montreal, etc.

CONSPICUOUS BY ABSENCE.

A PERUSAL of the long list of Coronation honors drives us to the conclusion that we electrical people must be a poor lot. We have not been able between us to secure so much as a knighthood. All we can do is to borrow a little reflected glory from Sir C. A. Parsons, whose doubly and trebly earned K.C.B. can be set down to the use of the steam turbine in the navy. His turbines might have driven every electrical machine in the world without bringing him titular recognition. And yet we played as big a part as the lord chamberlain himself in the coronation arrangements, to say nothing of our contributions to twentieth century civilization. Imagine what would have happened had the electrical world struck. No telephones to transmit instructions to police and military and functionaries; no electric railways and tramways to disgorge millions of loyal subjects along the lines of route; no cable messages of congratulation from abroad; no lights or lifts in Buckingham Palace; no illuminations save the few and far-between rain-smitten gas jets and fairy lamps. British electrical science and engineering can claim many representatives who are not without honor save in the court circles of their own empire. Perhaps it is because they are workers, and not talkers, or self-advertisers or party politicians.—Electrical Times.

BAKELITE DISCS.

Plastics, Ltd., 148 Van Horne street, Toronto, have recently placed on the market a composition known as "Bakelite" which when used for valve discs is said to be practically indestructible, even under the highest pressures, temperatures, moisture or chemicals. Wear from friction being the only means whereby depreciation takes place, makes Bakelite attractive for valve purposes. It has the further advantage of being readily reground and refaced.

Diesel Oil Engine Installation, at Yorkton, Saskatchewan

By C. T. R.

The Question of Economical Power Generation is a Live Issue at the Present Time. Steam Power, Hydraulic Power, Gas Engines Operating on Producer Gas, and Oil Engines are each competing to Secure a Lead. Location Enters Largely into the Selection However, and Doubtless each System can Show its Superlative Excellence Under Conditions Where This is Favorable. The Diesel Oil Engine Installation at Yorkton, Sask., Furnishes Power Users With Valuable Information as to What May be Obtained with a Similar Equipment, and Gives What We Believe to be as Yet, Somewhat Limited General Knowledge, Reliable Data of the Capacity Performance of this Type of Power Generator.

THIS Diesel engine built by Mirrlees, Bickerton & Day, Hazelgrove, Stockport, Eng., is of the standard three cylinder, 250 rev. 150 h.p. type. Owing to the altitude of Yorkton, and the fact that the engine runs at the lower speed of 240 revs. to suit the periodicity of Siemens alternator, the horse power is reduced to about 132. The alternator by Siemens Bros., Stafford, Eng., is an 80 k.w. 60 cycle, 3 phase machine; the exciter being driven as per illustration.

Operation and Output.

From information to hand, the engine has been running since 4th June, and has given satisfaction to all concerned. The cost per k.w. hour on the switchboard with oil at 10 cents a gallon, will not exceed 1¼ cents total operating charges, which include fuel, lubricating oil, waste, water, stores, wages, repairs, and maintenance. In Ontario and other parts, where oil can be bought for threecents per gallon, these costs would be reduced to something like ¾ of one cent per k.w. on the switchboard. The oil used is what is known as fuel or gas oil, having a specific gravity of from 0.8. to 0.9, and a calorific value of between 18,000 and 19,000 B.t.u. per lb.

The actual fuel consumption guarantees are as follows:—

Full load .....0.47 lbs. per B.h.p. hour
¾ load ... .0.49 lbs. per B.h.p. hour
½ load ... .0.57 lbs. per B.h.p. hour
¼ load ... .0.76 lbs. per B.h.p. hour

We expect to hear of these figures being lowered under continuous service.

Diesel engines use mineral oil of any kind, without alteration of design, although of course cheap oil is used for the sake of economy. Mr. Skinner, the consulting engineer, reports that the engine has been on a 5 hours' test, during which time there was generated 500 k.w., which is at the rate of 100 k.w. or 150 h.p. per hour, 334 lbs. of oil were used, being .668 per k.w. hour. The engine ran without trouble of any kind during this trial.

The Canadian Boving Company, 164 Bay street, Toronto, are the Canadian representatives of the Diesel Engine, and the following report received from Thos. Steele, their erecting and trial engineer, gives in detail quite an interesting account of the starting up of this the first Diesel engine in Canada.

Erecting Engineers' Report.

Yorkton, Sask., June 8th.—I beg to report starting up the Diesel engine on Saturday last. I ran it for 40 minutes with no load, and then shut down for inspection of all bearings, etc., which were found in good order. The engine started up without a hitch, running to full speed in about one minute. Mr. Skinner, consulting engineer, was present, along with several of the townspeople.

Sunday.—Ran engine several times for Mr. Skinner, to enable him to get the correct connections on switchboard.

Monday.—We ran up several times on the "tank load," and at 8 p.m. the town lights were switched on for the first time. The plant ran until 11.30 p.m., when we shut down for the night.

Tuesday.—Ran several times during the day on the "tank load," and at 8.30 p.m. switched on to the town lights. Everything worked well with the engine and generator, and at 11.45 p.m. we shut down.

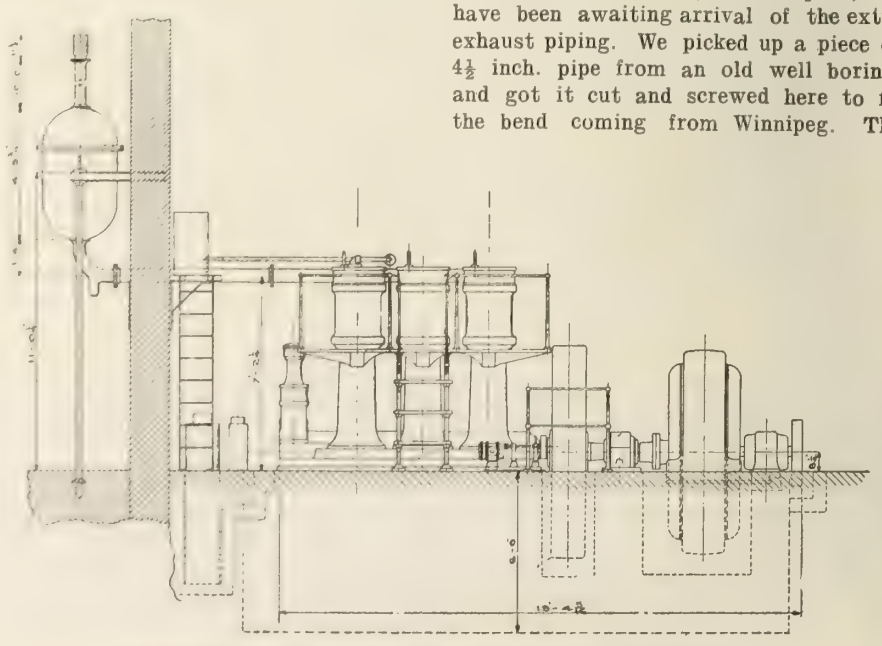
Wednesday.—We started the engine at 8.30 p.m., switched on the town lights at 8.35 p.m., and ran until 11.50 p.m. Everything went smoothly. Mr. Herbert of Messrs. Siemens called at the power station, and stayed until Thursday, to straighten out one or two items on the switchboard.

Thursday.—Mr. Herbert altered several of the connections made by the town engineer and Mr. Skinner. The engine ran several times to test the adjustments. We again started the engine up at 8.40 p.m., and switched on the town lights. This was the first time we took the indicating Watt meter reading. A summary of the fuel log is as follows:—

35 units generated.
8 gallons of fuel oil used.

This of course works out rather high per unit, but considering the load factor, it is good. We shut down at 12—7 a.m., making a run of 3 hours 47 minutes. Mr. Skinner stayed until the early train Wednesday morning, and from what he has seen of the engine, is, I think, highly satisfied with its performance. We were to have put the engine on full tank load, but there was some difficulty in getting a suitable regulation on the resistance; otherwise everything behaved A1.

As mentioned in my last report, I have been awaiting arrival of the extra exhaust piping. We picked up a piece of 4½ inch. pipe from an old well boring, and got it cut and screwed here to fit the bend coming from Winnipeg. The



Longitudinal Elevation, Diesel Oil Engine at Yorkton, Saskatchewan.

bend arrived by express at Yorkton, on Saturday at 8 p.m. We fixed it up, and had the engine under way shortly before 9 p.m.

The time involved from the opening of the water and fuel oil valves until the engine was running full speed was 55 seconds.

Boiler Construction

By H. S. Jeffrey

The Area of a Segment.

THERE is a general impression when bracing a segment, that the first thing is to find its area. The following formula is accurate enough for most purposes.

$$\frac{H^2}{2C} \text{ plus } \frac{2C \times H}{3} \text{ equals } A$$

H equals Height of segment in inches.
C " Length of chord in inches.
A " Area of segment in square inches.

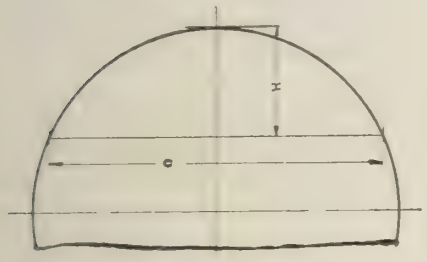


Fig. 40.

Example: Find area of the segment, Fig. 40, the height being 30 inches, and the chord 60 inches?

$$\frac{27.000}{120} + \frac{120 \times 30}{3} \text{ equals } 1{,}425 \text{ square ins.}$$

When bracing a segment, however, there is no need of finding its area, unless it be to obtain an approximate estimate of the number of braces required.

Example: If the area of the segment is 1,425 square inches and the working pressure is 100 pounds per square inch, and each brace is to resist 7,000 pounds, how many braces will be required to support the segment?

$$\frac{1{,}425 \times 100}{7{,}000} \text{ equals } 20 \text{ (plus) braces.}$$

This is only an approximate number of the braces required. The braces must be arranged so that the plate is properly supported, and when bracing a segment, it is a matter of impossibility to so arrange these that each will carry the same load; therefore, some will carry less than the maximum load allotted, and as no brace should carry an overload, more braces than the number found by the calculations given are used. The calculation gave 20 (plus) braces as the number required, but the

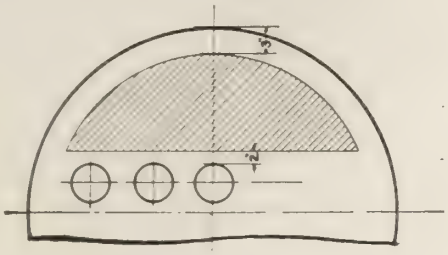


Fig 41.

distribution will be such that at least 22 will be required; perhaps, even 24.

Self-supporting Space.

There is also an impression that a portion of the flue sheet from the flange and above the tubes is self-supporting. This impression is wrong, for the assumption is that only the segment indicated by the shaded part in Fig. 41 is to be braced, while as a matter of fact the segment as indicated in Fig. 40 should be braced. What is meant by the so-called self-supporting part is that the plate is so rigid or stiff that it does not require bracing to prevent deformation. But, every square inch of segment is subjected to the steam pressure, and the whole load carried by the braces, therefore these must be arranged so as to protect the whole from deformation.

In arranging the braces it is well to do so in the manner indicated in Fig. 42, making the distances A, B, and C equal. Thus, if the distance from the inside of the flue head to the centre of the top rows of flues is 18 inches and three rows of braces are to be installed, then the distances A, B, and C would be 6 inches respectively. This would mean that each brace supported a space 3 inches above and below, and the flanged flue head D would be considered as a brace. Where the wrong impression comes in, is to consider that the pitch A, Fig. 42, can be made about one and one-half as great as the pitch B, or in other words point E instead of point D would be considered as a brace, thus making the pitch from the inside of the flanged head to the top row of braces the

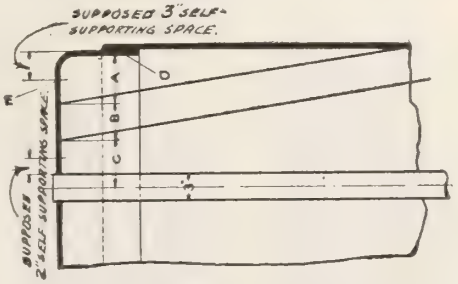
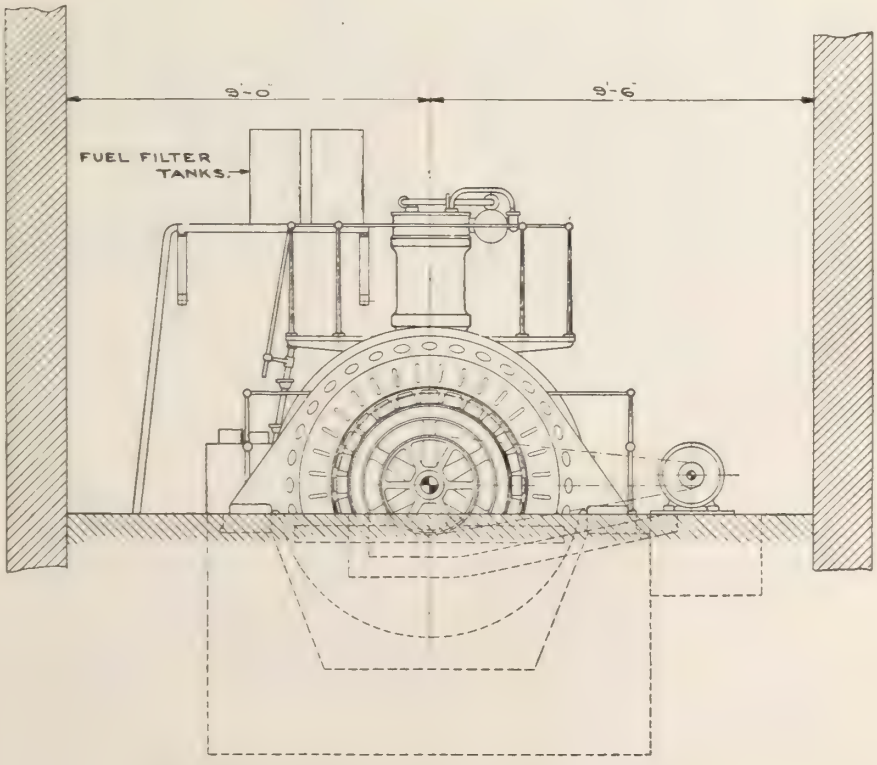


Fig. 42.

regular pitch plus the so-called self-supporting space, which is usually 3 inches.

Mr. J. J. Hackney, Guelph, has been appointed Commissioner of Public Utilities for the city of Port Arthur, Ont. The commissioner was engaged for a period of three years and his duties will commence on the first day of August, 1911.



Side Elevation, Diesel Oil Engine at Yorkton, Saskatchewan.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

OIL FILTERS.

OIL filters and oiling systems are among the important items in the equipment and operation of a modern power plant. Occasionally one sees in the technical journals, descriptions of crude home-made affairs, which in practice often prove a continual source of annoyance and inefficiency. Every user of lubricating oil knows that the larger

Fig. 2.

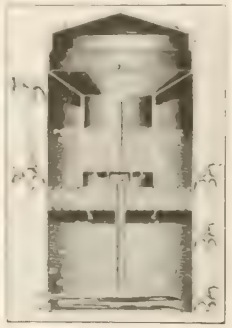


Fig. 3.

portion of what he buys is not consumed by the machinery bearings, especially with hand oiling, but passes through the bearing and is lost, unless provision has been made to collect it in drip pans.

Wasted Oil.

The oil lost in many plants, easily amounts to 50 per cent. of that used, and not only is there loss, but by being allowed to saturate the floor, everything adjacent to the machinery is kept in a greasy, dirty mess. In some plants cloths or waste are placed around engines or other machines to catch the runaway oil, and when these become soaked, they are thrown into the boiler furnace. This is positively shameful, because easily avoidable by the use of drip pans and a properly constructed oil filter. Practically speaking, the first cost of an oil filter is its only cost, and in ninety-nine cases out of every hundred, the filter will pay for itself by oil saved, in a very short period. When a filter is installed, the very best grade of oil may be put on all bearings, and used many times over. The best oils will make better operating conditions, for there will be fewer hot bearings and less trouble in other directions.

Quality of Oil Purchased.

In hundreds of plants only the cheapest oils are purchased, with the result that the engines do not develop full power, due to friction of bearings. Economy of operation demands that the quality of oil should be given first consideration, rather than its cost per gallon. I would suggest to employers who do not use a filter, to instruct their engineers to collect all waste oil for one month, and deposit it in a barrel. This is especially suggested to employers who imagine their plant oil consumption to be too small to warrant the purchase of an oil filter, and I venture to assert that a surprise is in store for them, when they see the quantity of oil that has been collected.

Benefits of Oil Filters.

A good oil filter will convert dirty oil into as safe and reliable a lubricant as it was in the first place, and the process may be repeated time after time. The Power House, as well as other engineer operator journals, is constantly warning engineers that it is the little leaks that eat up the profits, and no loss is so continuous, so frequently overlooked, and so easy of remedy as this oil waste. Large power plants are usually well equipped with oil-saving devices, but the small plants are the great sinners in overlooking this source

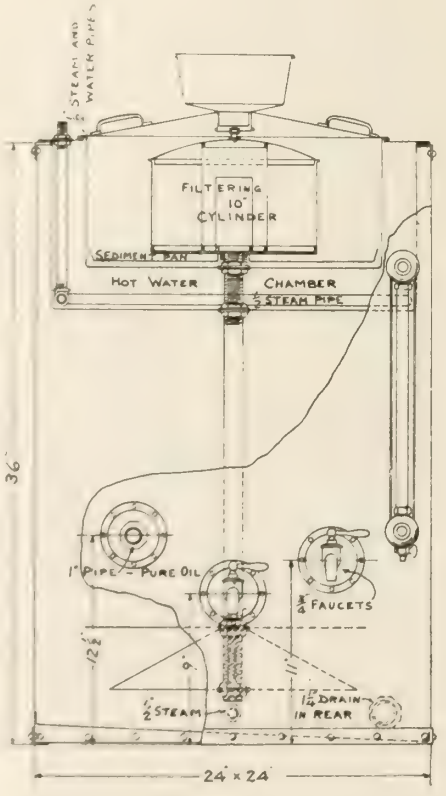


Fig. 1.

of loss. It has been proved in plants of 20 to 50 h.p. that filter repairs need cost no more than 50 cents a year, and that the oil reclaimed reduces oil bills at least 50 per cent. Continuous flow oiling and filtering systems for small plants can now be installed at small cost. With these, there is saving of labor due to reduction of oil handling, and the makers guarantee a saving in

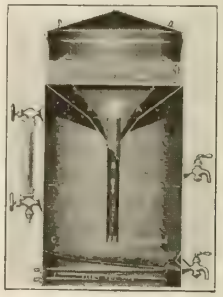


Fig. 4.

Fig. 6.

oil consumed of 50 to 80 per cent. over hand oiling, where drips are not collected.

Description of Oil Filters.

Fig. 1 shows the general arrangement of the Burt oil filter, of which an important point claimed by the makers, is the hot water chamber at the top instead of at the bottom as in most other makes. The sediment may be removed at any time, without interfering with the filtered oil.

Fig. 2 shows the American oil filter. It is almost a duplicate of the Burt; one being round and the other square, with a difference in the filtering chambers.

Fig. 3 shows the Cross type. Its construction and operation is so clearly shown that further description is unnecessary. It is especially recommended for engine and common machinery oils. The Burt and American filters are recommended for lard, cylinder, gas engine and heavy oils.

The Warden, Fig. 4, is of simple construction and easily cleaned.

Fig. 6 shows in section the White Star filter. The impure oil enters at A and passes through C to D. It is slightly heated at I, and is separated from the water by gravity. The water escapes to the sewer from an overflow at the back, and the unfiltered oil flows through J to filtering cylinders K, and into pure oil chamber L.

Fig. 7 shows a method of continuous oiling with steam operated oil pump, filter and storage tank. Its operation can be understood by a study of the sketch.

Fig. 8 shows a method of continuous oiling by a hand-operated oil pump. In

Fig. 7.

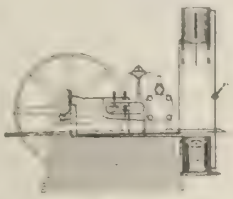


Fig. 8.

this case it will be necessary for the engine room attendant to occasionally rotate, for a few minutes, the small pump shown, in order to raise the oil to the tank.

Fig. 9 shows the same system with oil drips to tank under engine, and filter used as a storage and filter tank combined. The pump is operated by an attachment to some moving part of the engine.

I have only touched upon a very few of the many different oil filters made, but trust this article will be the means of preventing continuation of oil losses in small power plants, by causing the owner or engineer to investigate the benefits to be derived from adoption and installation of an oil filter. A paragraph from Mansel's Philosophy says:—"Great things are made up of little ones." A barrel of oil is only a large collection of drops, and a small waste each day becomes surprisingly large in a year.

ANSWERS TO ENGINEERS' QUESTIONS.

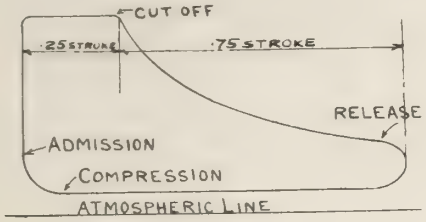
J. H. W., Toronto, submits the following answers to the first 10 questions appearing in our June issue, under the heading, "A Series of Practical Questions for Answer by Engineers."

A—1. Area of indicator card, 3.82 sq. in.; length of indicator card, 4.75 inches. Average height $= \frac{3.82}{4.75} = .8$ inch $40 \times .8 = 32$ lbs. M. E. P. To get average area of piston. Take twice piston area, subtract area of 4 inch. rod and divide result by 2.

$$\frac{(2 \times .7854 \times 26 \times 26) - (.7854 \times 4 \times 4)}{2} = 524.65$$

$$\text{I. H. P.} = \frac{P \times L \times A \times N}{33{,}000} = \frac{32 \times 4 \times 524.65 \times 146}{33{,}000} = 297.11 \text{ I. H. P.}$$

A—2.

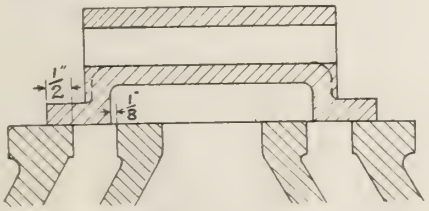


Diagram, Q. & A., No. 2.

A—3. 15 H. P. $= 15 \times 33{,}000 =$ 495,000 foot-lbs. per minute. Efficiency of pump is 60 per cent. 60 per cent. of 495,000 $=$ 297,000 foot-lbs per minute. $\frac{297{,}000}{140} = 2{,}121.42$ pounds of water.

A—4. Area of 6 inch cylinder $= .7854 \times 6 \times 6 = 28.27$ square inches. Then $28.27 \times 8 \times 60 =$ cubic inches of water delivered per minute $\frac{28.27 \times 8 \times 60}{231} = 58.74$ gallons of water delivered per minute.

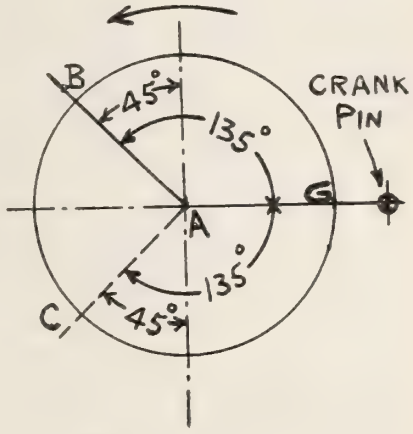
A—5.



Illustration, Q. & A., No. 5.

A—6. In the sketch, A is the centre of the shaft, and B. C. G. the circular path of the centre of the eccentric. Suppose the crank to be in the position shown, and that the engine runs in the direction indicated by the arrow. The angle of advance is 45 degrees; in other words, the eccentric is 90 + 45 or 135 degrees ahead of the crank; therefore AB represents the centre line of the eccentric. To make the engine run in the reverse direction, the centre line of the eccentric must be shifted to AC, which is also 135 dgrees ahead of the crank.

A—7. 1. More even turning effort on the crank shaft. 2. More heat units got out of steam, since it exhausts at a lower pressure. 3 The fall in tempera-



Diagram, Q. & A., No. 6.

ture of the steam between admission and final exhaust is split up into two stages, so that the range in each cylinder is moderate, lessening condensation.

A—8. Total heat of 1 lb. of steam at 2 lbs. pressure (absolute) $=$ 119.7 B.T.U. Temperature of 1 lb. of steam at 2 lbs. pressure (absolute) $=$ 126.3 degrees F. Gain of heat by water $=$ Loss of heat by steam. Each pound of water gains (120—70) $=$ 50 B.T.U. 1 pound of steam at 126.3 F. loses $1 \times (1119.7 - (120-32) = 999.7$ B.T.U. Then $\frac{999.7}{50} = 19.99$, say 20 lbs. as quantity of water required to condense 1 lb. of steam. Total amount required is 160×20 or 3,200 pounds.

A—9. A jet condenser is shown diagrammatically in sketch. A is the exhaust pipe from engine; B the water injection pipe, controlled by valve C; D the air-pump, and E the delivery pipe.

The cooling water should be supplied under head, because it should condense the steam before being brought under

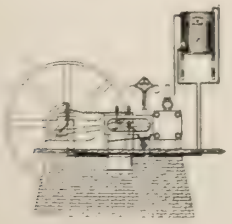
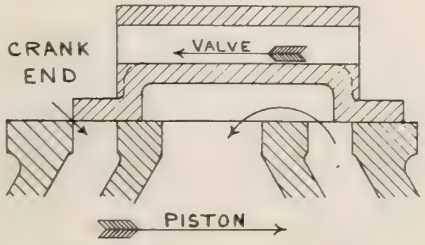
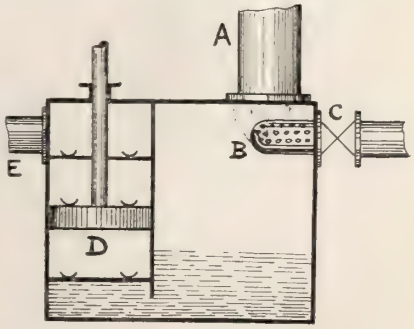


Fig. 9.



Illustration, Q. & A., No. 5.



Illustration, Q. & A., No. 9.

suction by the air pump. The sketch makes this abundantly clear.

A—10. The condenser enables more work to be got from a given amount of steam, since the expansion of the steam is carried down to the pressure of the condenser, instead of being exhausted, as in non-condensing engines, at a pressure higher than that of the atmosphere. Vacuums ordinarily used in condensers range from 20 to 28 inches, equivalent to a pressure of about 5 lbs. to 1 lb. above absolute zero of pressure. A condensing plant should not be used unless an abundant supply of water is obtainable without cost, except that of initial outlay and pumping charges. Further, it should not be used if more advantageous use can be made of the exhaust steam; such as for heating and drying purposes, etc.

STEAM CONSUMPTION FROM INDICATOR DIAGRAM.

Recently one of our correspondents asked to know the method of calculating the steam consumption of a steam engine from its indicator diagram. One way that I have found very simple (perhaps the simplest of any) is as follows:—

Method of Procedure.

Referring to the accompanying diagram, the line CD is the atmospheric line and EF is the perfect vacuum line. Select a point A on the compression line and a point B on the expansion

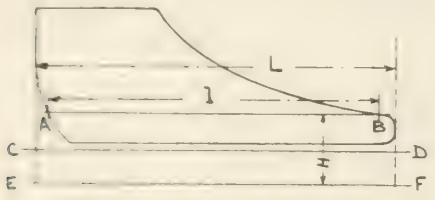


Diagram. Steam Consumption.

line, both points to be equidistant from the perfect vacuum line E.F. Next, by means of the scale corresponding to the spring by which the diagram was traced, measure the absolute pressure from vacuum line of the points A and B. This pressure is shown in the figure by the line H. Find the weight of a cubic foot of steam at the pressure measured, by consulting a table of properties of saturated steam, found in most engineers hand and pocket books

Multiply the weight of a cubic foot of steam at the observed pressure, by the distance A.B. in inches and decimal parts of an inch, and that product by the constant 137.50. Divide the product by the mean effective pressure as found from the diagram, and then by the over all length of the diagram, in inches and decimal parts of an inch. The result will be the number of pounds of steam consumed per indicated horsepower per hour, as shown by the diagram.

Arithmetical Shewing.

The foregoing may be written as an arithmetical statement, which can be understood at a glance.

$$\frac{137.50 \times Z \times W}{P \times L} = \text{steam consumption}$$

in pounds per horsepower per hour. In the formula the values are as follows:—

Z = distance between the points A and B in inches.

W = weight of a cubic foot of steam at the observed pressure. From steam tables.

P = the mean effective pressure as found from the diagram in the usual manner.

L = the overall length of the diagram in inches.

137.50 = a constant mathematically derived.

By this method, the clearance need not be taken into account at all, because the absolute pressure at the points referred to, is the same, and you are dealing with a certain volume of steam represented by length of $\frac{Z}{L} \times$ length of stroke of piston $\times$ area of piston.

In conclusion, I would say that while the method just given is as correct as any in its results, (when considering diagrams) the **true** steam consumption cannot be found from an indicator diagram, owing to the presence of condensation, of which the diagram takes no account. The actual consumption, as found from a regular test, is or will be more than that found from an indicator diagram.—Chas. J. Mason.

Correspondence

In reply to query of J. O. Graham, Orillia, in June issue, I beg to submit the following. Napier Law states that weight of steam in lbs. per second

$$= \frac{\text{Area sq. in.} \times \text{absolute pressure}}{70}$$

70=a constant.

Example:

$$W = \frac{1 \times 115}{70} = 1.64 \text{ lbs. per sec.}$$

$1.64 \times 3{,}600 = 5{,}904$ lbs. per hr.

For the second part of Mr. Graham's query, some dimensions would have simplified matters greatly. The following, however, will put him on the right track of getting the radiating surface required. Assume a kiln of the following dimensions:

$100 \times 10 \times 15$ ft.=	15,000 cu. ft.
area of two sides $100 \times 10 \times 2$=	2,000 s. ft
area of two ends $15 \times 10 \times 2$=	300 sq. ft.
area of top 100×15=	1,500 sq. ft.
Total	3,800 sq. ft.

Radiation from brick walls per sq. ft. area, per hr., per degree, difference in inside and outside temperature for given thicknesses are as follows:

8	12	16	20	24 inch walls.
.46	.32	.26	.23	.19 H. U. lost.

1 H.U. will heat 4.2 lbs air, or make 55 cu. feet rise one degree in temperature. Heat required for air to give 100 changes per hour $= \frac{15{,}000 \times 10}{55} = 2{,}727$; total area of walls at 16 inches thick $= 3{,}800 \times .26 = 988$. These quantities multiplied by the difference between inside and outside temperature, assuming zero weather outside $= 2{,}727 \times 180 = 490{,}860$; $= 988 \times 180 = 177{,}840$. Total H. U. required = 668,700. It is found by experiment that 1.8 H. U. is given off per sq. ft. per hr., per difference between inside and outside temperature of radiator.

Steam at 2 lbs. gauge is practically 220 deg. F. and we have to maintain a temperature of 180 deg. F. Therefore $220 - 180 = 40$. $40 \times 1.8 = 72$ H. U. given off per sq. ft. radiator.

H. U. required = 668,700

Radiating surface = $668{,}700 \div 72 = 9{,}287$. Condensation per hr. =

$$\frac{9{,}287 \times 1.8 \times (220-180)}{960} = 696 \text{ lbs.}$$

Trusting this will be of some service.—H. PREW.

H. Prew, Montreal, replies to British Columbian's queries in the June issue of the Power House, as follows:

950 H. P. $\times$ 25 lbs. per hr. = 24,000 lbs. Calculate the pump theoretically to do twice the amount of work specified, as losses occur from leakage and slip at the plungers and valves.

$24{,}000 \times 2 = 48{,}000$ lbs., the theoretical quantity required. $48{,}000 \div 62 = 775$ cubic feet per hour required. $775 \div 60 = 13$ cubic feet per minute, required.

It is inadvisable to exceed 100 feet per minute of plunger speed,

$$\frac{13 \times 1.728}{100} = 225 \text{ c. inches per stroke.}$$

$$\frac{225}{12} = 18.75 \text{ sq. inches plunger area.}$$

As the area of 5 inches diameter is 19.6 sq. inches, and 18.75 sq. inches is required, the former would likely be adopted; making one pump at its water end, 5 inches diameter, available per 12 inch stroke, and running 100 strokes

per minute. Other diameter stroke and plunger speed proportions may be adopted, their combination being such that the 13 cubic feet of water per minute is properly taken care of.

In the May issue, C. R., Cape Breton, N.S., asks what is the correct diameter of cylinder, for a hoisting engine geared to a drum 4 feet dia. with gears having a ratio of 1 to 4. A weight of 4,000 pounds is to be raised 180 feet in 4 minutes. The stroke of the engine is $1\frac{3}{4}$ times the diameter of the cylinder, and the mean effective pressure is 45 pounds per square inch. The answer to this problem will depend upon the combined efficiency of the hoist and engine. In the average steam winch it will probably not exceed 50 per cent., and this value will be assumed in working out the solution.

The weight is raised at a speed of 180 feet in 4 minutes or 45 in 1 minute.

4,000 pounds $\times$ 45 feet=180,000 ft. lbs. of work.

33,000 ft.-lbs. per minute=1 horse power.

$$\frac{180{,}000}{33{,}000}=5.5 \text{ horse-power (nearly).}$$

Theoretically, therefore, we need 5.5 H.P., but as the efficiency of winch is only 50 per cent., we actually need 11 H.P.

The size of the rope is not stated, but let us assume that it is 1 inch diameter. Since the drum is 48 inches dia., and the rope 1 inch, one revolution of the drum will raise the load a distance equal to the circumference of a 49-inch circle; expressed in feet this is

$$\frac{3.1416\times 49}{12} \text{ or } 12.83 \text{ feet.}$$

To wind up 45 feet of rope in 1 minute the drum must make $\frac{45}{12.83}$ or $3\frac{1}{2}$ revolutions per minute. The gears have a ratio of 1 to 4, so the speed of the crank shaft will be $3\frac{1}{2}\times 4=14$ revolutions per minute. This is too low a speed for a steam winch. A single cylinder engine would be liable to stop on the dead centre, unless fitted with a heavy fly wheel, which is unusual in a winch. We must therefore assume that there are two cylinders, with cranks at right angles, and even then the speed is too low. 11 horse power is needed to raise the load, or $5\frac{1}{2}$ horse power from each cylinder.

Formula for indicated horse power is:

$$\frac{P\times L\times A\times N}{33{,}000}$$

Where

P=mean effective pressure in lbs. per sq. inch.

L=length of stroke in feet.

A=area of piston in sq. inches.

N=twice the number of revolutions per minute.

If we call the diameter of cylinder, D inches, then the stroke will be $\frac{1\frac{3}{4}D}{12}$ feet, or .1458 D feet. The area of the piston will be .7854 D^2 sq. inches; and the letters in the Horse Power formula will have the following values:—

P=45 pounds per sq. inch.

L=.1458D feet.

A=.7854D^2 sq. inches.

N=28.

The horse power developed by one cylinder is $\frac{P\times L\times A\times N}{33{,}000}$, and this equals 5.5. We, therefore, get

$$\frac{45\times .1458D\times .7854D^2\times 28}{33{,}000}=5.5$$

This works out to

$.00437D^3=5.5$

$D^3=1258$ (nearly)

$D=10.8$, say 11 inches.

The stroke is $1\frac{3}{4}D$ and $11\times 1\frac{3}{4}=19\frac{1}{4}$ inches.

Two cylinders, each 11 inches dia. $\times$ $19\frac{1}{4}$ inches stroke are required; but, as already stated, the speed of the engine is too low at 14 r.p.m., therefore it would be better to reduce the cylinders and speed up the engine; re-designing the gearing (increasing the ratio) to keep the hoisting speed at the present figure, if necessary.—J.H.W.

H. Howard, Welland, Ont., requires the address of the publishers of Fowler's Mechanical Engineers' Handbook, sold in England at 12 cents.

We have not been able to find out who they are, but suggest Emmott & Co., 65 King Street, Manchester, England, publishers of the Mechanical World Pocket Diary and Year Book. This also sells in the Old Country at 12 cents. Perhaps some of our readers will be able to supply the information.

Replying to query by Chas. Whyte, Cumberland, B.C., as to why the latent heat in any kind of vapor should be 650, it seems to us that a wrong impression has been taken of the information furnished. We have not seen the item referred to, and suggest drawing the publishers' attention to it, for further explanation. We may not criticize.—C.T.R.

In reply to W. H. Rennie, Kilmaurs, I beg to state that there is a certain routine adopted in setting Stephenson's reversing link motion, and which varies to a lesser of greater extent according to the particular purpose for which the engine is used. If W.H.R. will let me know the points which he wants cleared up, same will have attention in next issue.—P.H.

Engineers' Licenses

By Halyard.

AMONG other topics of importance to be discussed at the Stratford C.A.S.E. Convention, those pertaining to engineers' licenses for boiler inspectors and mutual recognition by any province of the Dominion, of licenses granted by each or all of the others, should be kept well to the front.

Boiler Inspectors' Licenses.

Regarding these, it surely is highly inconsistent that boiler inspectors representing insurance companies in the States, should be able to pursue their calling in the Province of Ontario without possessing an engineer's license. The fact that 30 or 40 of these men act more or less in this capacity, particularly in the district between Niagara and Detroit, seems to show lack of interest by those most directly affected.

I do not doubt for a minute but that all of them are duly qualified men, a circumstance which, while granted, still leaves the matter wrong in principle. No boiler inspector with an Ontario license may do similar work in the States, therefore unless there be full and free reciprocity, steps should be taken to insist that these boiler inspectors from across the line must have the necessary engineer's license.

Most countries have strict regulations for the design, construction and operation of steam boilers and engines, and in addition take special pains to ensure that those who inspect these are fully licensed. Canada has no call to be lacking in this important requirement.

Provincial Transfer of Licenses.

That the existing conditions whereby an engineer's license secured in one province is valueless in another, entail hardship in numerous cases, is a fact known to engineers generally. Why it should continue to be allowed to exist, beats me. We live in a rapidly developing country, where men are continually being drafted from one province to another. The engineer, for he is one of those spoken of, finds his eastern license useless in the west, and straightway strikes all manner of inconvenience. Could not the various engineers' licensing boards meet once or twice a year in some more or less central location, and there determine a common basis of examination, whereby men holding the certificate of either province would be assured of at least transfer when occasion arose? Arrangements come to at such a meeting would be understood to hold good until the next conference.

News of Societies

Officers of Engineering Societies and Current News of Associations

LONDON ENGINEERS' SUMMER OUTING.

CANADIAN Association of Stationary Engineers, London, No. 30, held its second annual picnic at Springbank, Saturday, June 24th. The engineers were dressed in blue overalls.

A feature of the picnic was the supper, to which 225 sat down. The cake contest caused no little excitement amongst the engineers' wives and friends, the judges finding it difficult to decide on the winner. There were many cakes and all were up to the standard. After devouring a large amount of them, the prize was awarded to Mrs. J. E. Middleton. The judges were: T. W. McFarland, Harry Clark and Mrs. E. Thomas, of St. Thomas. After tea Mrs. E. Leonard was asked and kindly consented to distribute the prizes.

When the prize distribution was over, the picnickers adjourned to the ball diamond, where an exciting ball game was played between two teams of engineers, captained by Brother Campbell and Brother Moll. Brother Moll's team defeated Brother Campbell's team by a score of 6 to 5. George E. Fisher was umpire. After the game, the umpire presented the captain of the winning team with a handsome butter dish, and a box of cigars, donated by the Canadian Casualty Boiler Insurance Company.

The following is a list of the different events and the winners:

Programme and Winners

Children's race, 8 years and under, 50 yards.—First prize, brooch, donated by lodge, Miss Galloway; second prize, brooch, donated by lodge, Miss Swazie.

Girl's race, 12 years and under, 50 yards.—First prize, 2-lbs. box chocolates, donated by D. S. Perrin & Co., Miss Johnston; second prize, 1½-lbs. box chocolates, donated by D. S. Perrin, & Co., Miss Galloway.

Boys' race, 8 years and under, 75 yards.—First prize, ball glove, donated by lodge, Master Swazie; second prize, jackknife, donated by lodge, Master Campbell.

Single ladies' race, 15 years and over, 75 yards.—First prize, sugar spoon, donated by lodge, Miss Johnston; second prize, pair of scissors, donated by lodge, Miss Hartte.

Boys' race, 15 years and under, 100 yards. First prize, ball glove, donated by lodge, Master Swazie; second prize, jackknife, donated by lodge, Wm. Swasie.

Engineers' wives, potato race.—First prize, 1 model tea kettle, donated by McClary Mfg. Co., Mrs. J. E. Middleton; second prize, 1 tea pot, donated by McClary Mfg. Co., Mrs. Hazlewood; third prize, 1 wash bowl, donated by McClary Mfg. Co., Mrs. Fletcher.

PERSONAL, DISTRICT AND SOCIETY NEWS.

Devoted to brief reports of the various engineering societies and associations of the Dominion; notices of meetings, reading of papers, license examinations, social and personal paragraphs. The co-operation of secretaries is requested to make this section of our paper a complete record of the doings of each month in these directions.

Men's boot and shoe race, 50 yards and return.—First prize, 1 pair of shoes, donated by Ed. Warren, J. R. Stephenson; second prize, Stilson wrench, donated by Empire Brass Co., O. Hannan; third prize, Wescott wrench, donated by Empire Brass Co., H. C. Barnes.

100 yard dash, fat men's race, 180 lbs. and over.—First prize, 1 Pean hammer and 1 two-ft. rule, donated by Warren Bros., W. Costello; second prize, 1 speed indicator, donated by London Eng. Supply, W. Paynter; third prize, 1 year's subscription for Engineer's Journal, Toronto, G. Moll.

Married ladies' guessing contest.—First prize, 1 Star mantle lamp, donated by Bro. G. England, Mrs. J. E. Middleton; second prize, 1 doz. boxes of Corn Flake, donated by Health Food Co., Mrs. G. Galloway; third prize, $1 worth of bread tickets, donated by Fawkes' Bakery, Mrs. J. Carr.

Men's jockey race, 50 yards and return.—First prize, 2 speed indicators, donated by lodge, Galloway and Whitcheter; second prize, 2 steel rules, donated by lodge, Paynet and Hannah.

Children's scramble contest.—Candy donated by D. S. Perrin & Co.; popcorn, donated by C. R. Somerville & Co.

Engineers' 100 yard dash, 40 years and over.—First prize, 1 set of spanners, donated by lodge, H. Clark; second prize, 1 small Pean hammer, donated by J. G. Steele, hardware, W. Costello; third prize, ⅛-inch Stillson wrench, donated by Jas. Bailey, G. England.

Engineers' club race, 100 yards.—First prize, 1 tool cabinet, donated by Dominion Office Fixture Works; second prize, 1 carving set, donated by Cowan's Hardware; third prize, 1 12-inch gas plyers, donated by Westman's Hardware.

Smoking contest, 50 yards and return.—Bro. Galloway supplies the cigars.—First prize, 1 Rayo lamp, donated by Queen City Oil Co., W. Paynter; second prize, 1 load of wood, donated by D. H. Gillies Coal Yard, G. Galloway; third prize, 5 galls. of coal oil, donated by Canadian Oil Co., J. Reid.

Members' standing jump.—First prize, 1 pair of dumb bells, donated by Mr. Arnold Swazie, G. Galloway; second prize, 1 pair of dumb bells, donated by London Foundry, W. Costello.

Quoit contest.—First prize only, for 1 set of quoits, donated by Mr. Arnold Swazie, of London Foundry, H. Clark.

Children's race, 6 years and under, 25 yards.—Special prizes donated by Mrs. S. Cosford.

Cake contest, best baked layer cake.—One sack of Hunt's Diamond Flour, donated by Hunt's Flour Mills, Mrs. J. E. Middleton.

Baseball match.—Called at 6.30 p.m. sharp. Team captains are G. Moll and D. F. Campbell, Moll's team won by 1 run. Canadian Casualty Boiler Ins. Co., Toronto, donated a box of cigars to the winning team, and G. Fisher, Can. Fairbanks Co., a butter dish.

Sports to members only. Tea at 5.30 p.m. No member entitled to more than two prizes.

General Committee.—Bro. J. E. Middleton, chairman, Bro. G. Galloway, treas., Bro. H. C. Barnes, sec., Bro. G.

Moll, Bro. S. E. Cosford, Bro. D. Fowler.

Sports Committee.—Bro. G. Moll, Bro. G. Galloway, Bro. S. E. Cosford.

Printing Committee.—Bro. W. J. Paynter, Bro. R. Roote, Bro. C. Rodgers.

Prizes presented by Mr. F. E. Leonard.

Mr. W. P. Morrison, Halifax, has been appointed engineer for South Vancouver, B.C.

Mr. A. C. D. Blanchard has been appointed to the position of City Engineer for Lethbridge, Alta.

Mr. E. B. Jones, city engineer, Chatham, Ont., has resigned his position, after fifteen years' service.

Parker H. Kemble, district manager of the Brooklyn Edison Company, has been appointed general sales manager of the Toronto Electric Light Co.

Mr. C. A. P. Turner has opened an office in the Canadian Building, Winnipeg. He will design reinforced concrete bridges, buildings, and manufacturing plants.

Mr. C. W. Ward, chief engineer of Reavell & Co., Ipswich, England, has been the guest of Vandleur & Nichols, Toronto, who represent Reavell & Co. in Canada.

Mr. Wynn Meredith will be the consulting engineer in charge of the work to be undertaken by the city of Victoria, B.C., in developing the Sooke Lake scheme of water supply.

Mr. R. S. Lea, Montreal, has been recommended to the council of Vancouver and the outlying municipalities, as consulting engineer for the Greater Vancouver sewerage system.

Mr. C. R. Young has withdrawn from the firm of Barber & Young, bridge and structural engineers, in order to devote his entire time to academic work as lecturer in structural engineering in the University of Toronto. The practice will be continued by Mr. Frank Barber, 57 Adelaide St. East, Toronto.

Mr. Alexander Milne, the newly elected president of the American Water Works Association, was born in Aberdeen, Scotland, in 1860. With his parents he removed to Canada in 1875. Since that time he has lived in Ontario. For the past twenty-four years he has been in municipal engineering, and has occupied his present position as engineer superintendent of the Water Works Department of St. Catharines, Ontario, Canada, for over 10 years.

At a meeting of No. 31, C.A.S.E., Stratford, held on 28th June, the following officers and representatives were elected for the ensuing year. Hon. president, R. Patterson, master mechanic, G.T.R. shops, Stratford; past president, Alexander Scrimgeour; president, A. Kastella; vice-president, J. A. Innis; financial secretary, J. A. Robertson; recording secretary, James Swanson; treasurer, Geo. Hind; conductor, Thos. Griffin; doorkeeper, Geo. Grevison. Alex. Scrimgeour and A. Kastella were chosen delegates to represent the lodge at the C.A.S.E., 1911 convention in Stratford.

Members of the North-west Association of Stationary Engineers waited on T. Brisette, assistant engineer at the power plant and presented him with a gold watch and an address, previous to his departure for Montreal where he will enter an advanced course in engineering. The address was read by George Inglis, secretary of the Association. Mr. Brisette leaves the city's employ in the course of the next few days, but will remain in Edmonton for some time before going to Montreal.

CANADIAN STATIONARY ENGINEERS.

The entertainment committee of the Stratford Lodge, C. A. S. E., extend to you a cordial invitation to attend the Canadian Association of Stationary Engineers' Convention, being held in that city on July 25-26-27. Your duties will, in the majority of cases preclude any possibility of your accepting the proferred hospitality, and you will of necessity be dependent on some substitute to convey to you a proper and true record and conception of what takes place at this, to you, all-important function. The Power House will, as usual, be representative of the absentees, and will furnish in its August issue a snappy account of all that transpires in word and deed. No stationary engineer can afford to be without this monthly stimulus to second his own personal efforts, and those not yet on its regular subscription list will find the present a golden opportunity to hitch-up.

The Engineers' Club of Toronto has secured an option on the property known as the "Saturday Night" building on Adelaide Street. The building stands on a lot, forty-two feet five inches by eighty feet, and has lanes running along the east and north sides. It is seven and a half storeys high, and built of sandstone and red brick. It will receive a thorough renovation. Three top floors will be used for club purposes exclusively, and the lower rented as offices for engineers and architects. A roof garden is contemplated. Arrangements for financing the building are said to be complete, and occupancy is expected in a year.

Ottawa No. 7, C.A.S.E. held a most interesting and successful meeting recently. The attendance was large, and the subjects of lecture by Bros. A. Campbell, F. Mirrell, and F. Roberts on evaporation and combustion were attentively listened to and initiated a discussion in which a large number of those present took part. The secretary, Bro. C. J. Lake, gave his experiences with the Belleville, Babcock and Wilcox and Niclausse boilers, during service in the British navy. At this meeting, plans were made for a picnic to Aylmer on Dominion Day, and steps taken to secure the attendance of all the engineers in the city together with their wives and children.

One of the best attended meetings of lodge No. 25, C.A.S.E., was held in Spragge's Hall, Owen Sound, on Thursday, June 22, 1911. After the usual routine business, the election of officers for the ensuing year took place, and resulted as follows:—President, G. Thomas; 1st vice-pres., J. Brillinger; 2nd vice-pres., G. Sainsbury; secretary, W. J. Needham; treasurer, Wm. Bell; conductor, E. Hooey; doorkeeper, J. Snowball; trustees, J. Thompson, E. Hooey, G. Sainsbury; auditors, H. Weaver and T. Watson; delegates to Stratford convention, G. Thomas, alternative delegate, R. Walker. The secretary's address is 2089, 3rd Ave. E., Owen Sound, Ont.

London, No. 30, C.A.S.E. held their regular meeting in the club room, 211 Dundas Street, on June 26th. There was a good turn-out of members, and the meeting, after the regular business had gone through, proceeded to the election of officers for the ensuing year. This resulted as follows:—President, S. Cosford; vice-president, J. W. Paynter; recording secretary, D. F. Campbell, 114 Askin Street; financial secretary, W. Costello; treasurer, W. Rogers; conductor, J. E. Middleton; doorkeeper, J. R. Stephenson; trustees, G. Galloway, A. Fletcher, H. C. Barnes; convention delegates, G. Moll and S. Cosford, with J. R. Stephenson, and G. D. Bollon as alternatives.

Mr. Archibald Denny, of the firm of Denny Bros. & Denny & Co., shipbuilders and engineers, Dumbarton, Scotland, recently had the honorary degree of LL.D. conferred on him by the University of Glasgow, Scotland, for his services in engineering research work, technical education advancement and other industrial movements. Dr. Denny's firm are associated with the enterprise of Denny & Bullen, who are establishing shipbuilding and engineering works on the Pacific Coast.

A Boiler Plant Waste Meter

IT has been thoroughly demonstrated that waste of heat in boiler plants may be greatly reduced by more careful attention to what is going on in the furnace. As with the improvements which have been obtained in the engine room by the use of the indicator, the thermometer the steam gauge, and the use of electrical measuring instruments, so in the boiler plant, the measurement of coal and water on scales or by meters, and the measurement of waste by a waste meter, result in considerably decreasing the cost of power production.

Percentage of Heat Available.

On the average it may be stated that only 60 per cent. of the heat in the coal enters the boiler, and 40 per cent is wasted. Of this 40 per cent., the total waste is distributed as follows: loss in radiation, 5 per cent.; loss in soot and smoke, 1 per cent.; loss represented by actual loss of coal through the grates, 2 per cent.; loss due to combustion of the carbon to carbon monoxide instead of dioxide, 2 per cent.; heat carried away by the chimney gases, due to their temperature, 30 per cent.

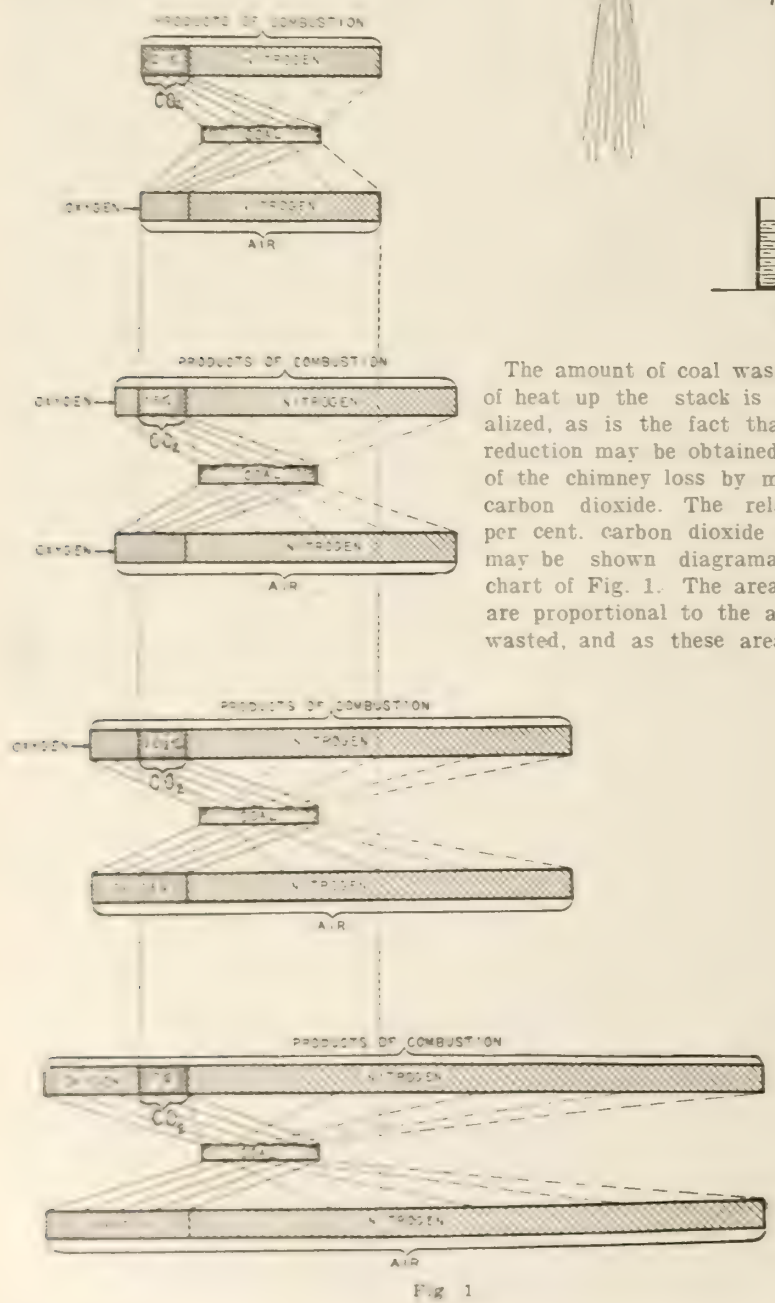


Fig 1

The amount of coal waste, due to loss of heat up the stack is quite fully realized, as is the fact that considerable reduction may be obtained in the extent of the chimney loss by measurement of carbon dioxide. The relation between per cent. carbon dioxide and heat lost may be shown diagramatically by the chart of Fig. 1. The areas in each case are proportional to the amount of heat wasted, and as these areas are reduced by decreasing the excess air, the per cent. of CO_2 is increased.

CO_2 Recorder.

The CO_2 recorder was devised to automatically inform the engineer of the amount of waste occurring. The CO_2 measurement gave an indication of how much air is being used per pound of coal; the most important item in determining the amount of loss in the waste gases going up the chimney. The other important item, the temperature, is taken by pyrometers, mercury thermometers or other means. Caustic potash absorbs carbon dioxide, therefore this is the fundamental principle of all instruments for making a measurement of CO_2. In the older types of automatic recording instruments, bells or jars for measuring the gases before and after the CO_2 was absorbed, were used. The difference in volume of the gas before and after the CO_2 was abstracted, gave a measurement of carbon dioxide in the gases.

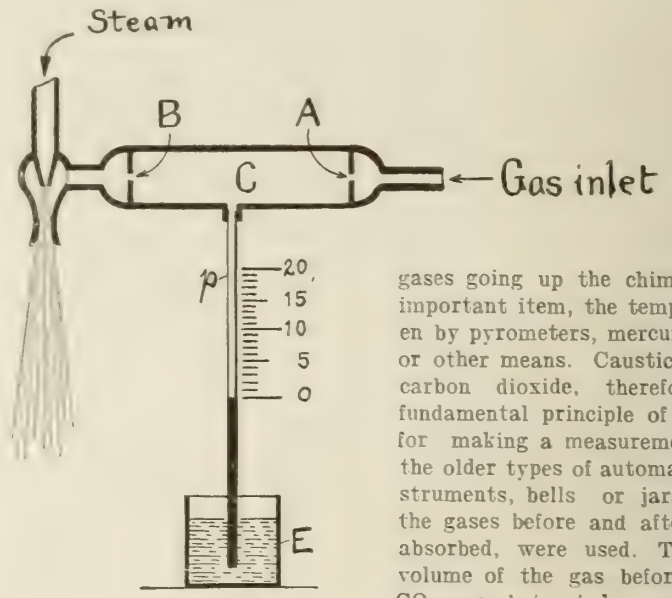


Fig. 2.

The limitations of such instruments may be briefly summarized as follows: The record cannot be continuous, as the sampling must be done intermittently. No indicating devices may be used in connection with the machine. One machine does not give both carbon dioxide and temperature. Only one recording chart may be obtained, and this must be placed at the machine proper, located in the boiler room. If, instead of measuring the per cent. carbon dioxide by measuring the actual volume of a given amount of gas before and after the carbon dioxide has been abstracted from it the pressure of the gas is measured, then the change in pressure due to the reduction in volume when the CO_2 is absorbed, will give a ready and reliable method of measurement.

The diagram fig. 2 shows how this principle is employed in the waste meter, which measures both percentage of carbon dioxide and temperature. Gas is drawn through the apparatus continuously by a small steam aspirator. Between the two apertures, in the chamber marked C, the carbon dioxide is absorbed (in the case of the carbon dioxide instrument) and thus the volume of the gas between the apertures is reduced by an amount depending upon the amount of CO_2 present. Any reduction in the volume of the gas between the two apertures increases the vacuum. These

changes are proportional to the amount of CO_2 absorbed, and thus the suction or partial vacuum forms a basis for indicating and recording variations in carbon dioxide in flue gases.

The indicating instruments are simply columns properly calibrated and are supplied at the machine proper and also as shown in figure 3, for the front of the boiler. The indicators at the boiler front are found to be most useful, in that reference can be made continuously to them, whereas the recording charts are more valuable as permanent records from which to obtain average results with different kinds of coal, different grate area, different drafts, etc. The recording instruments may be placed anywhere, and any number of them may be used, as all simply record the partial vacuum or suction.

Temperature Recorder.

As the same principle and similar apparatus is used to measure temperature, it is evident that a very effective combined CO_2 and temperature machine or waste meter is available. In measuring temperature, instead of the change in vacuum being produced by absorbing part of the gas between the apertures, change in vacuum is secured by reason of the difference in temperature between the two apertures. One aperture is in a nickle tube placed in the flue or other part of the furnace, and the other maintained at a constant temperature by exhaust steam.

The appearance of a combined instrument of this type is seen in figure 4. The two indicating columns for per cent. carbon dioxide and for temperature are at the front of the instrument, while at the left and right, on the board, are the recording gauges. In the boiler room proper, is placed the CO_2 indicator.

WATER POWERS AND ELECTRIC SMELTING.

Owners of water rights in Canada will be interested in the progress that has been made during the last two years in the electric smelting of iron ores. The furnace which has proved successful, is that known as the Gronwall, and at the present time there are eight of these furnaces working or in course of erection in Norway and Sweden, using altogether 25,000 e.h.p., The largest unit so far, is of 4,000 e. h.p., but owing to improvements made in carbon-electrode manufacture, it is possible to build units of 6,000 e.h.p. The current used is three-phase, transformed down to between 50 and 100 volts.

These furnaces require only one-third of the fuel used by the blast furnace, and produce over three tons of pig iron per e.h.p. year. The pig iron is of exceptional quality, and its process of manufacture is causing something akin to revolution in Swedish iron and steel circles. The Canadian Boving Co., 164 Bay street, Toronto, Ont., have acquired the patent rights in Canada and U. S.A. for this reduction furnace, and also the Gronwall steel-refining furnace.

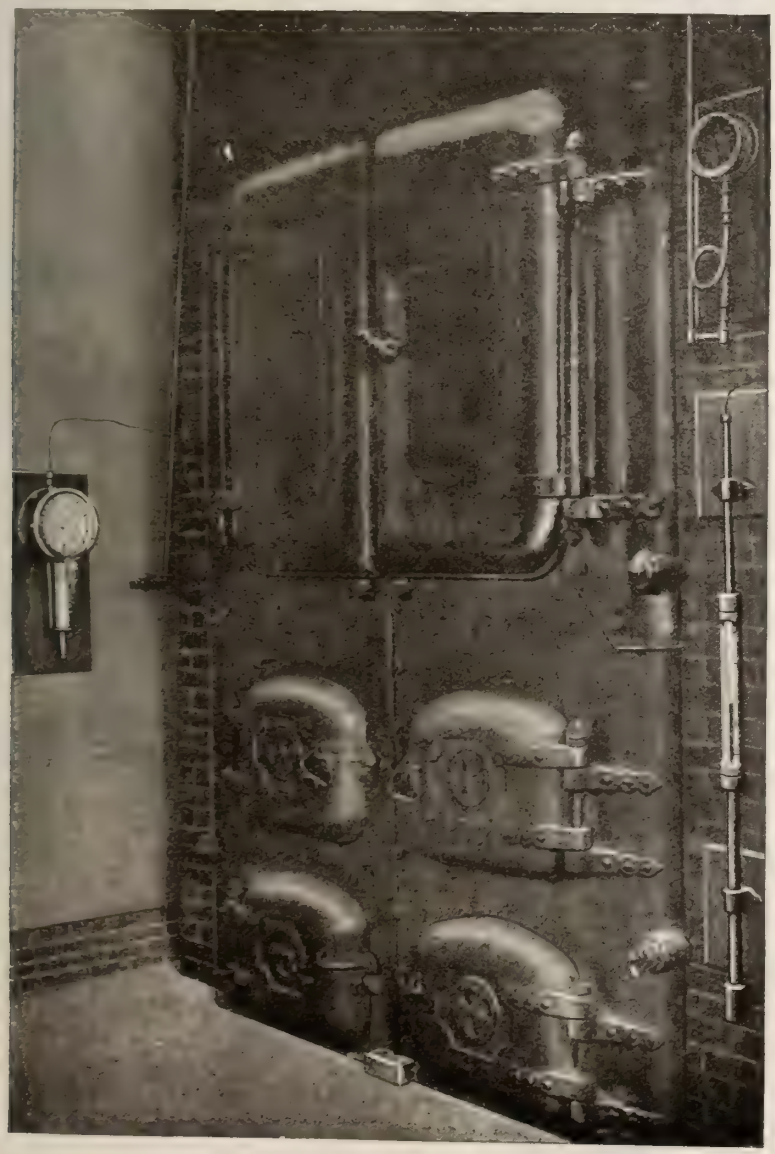


Fig. 3.

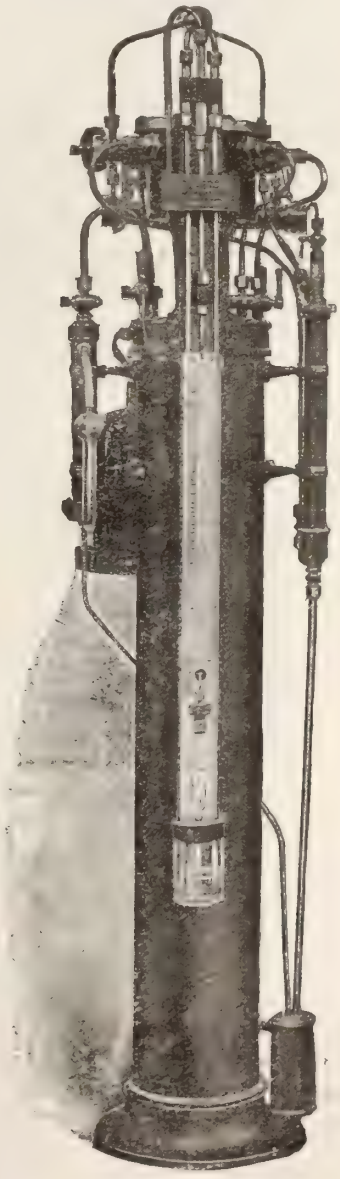


Fig. 4.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

TWENTIETH CENTURY AUTOMATIC LOOSE PULLEY OIL CUP.

THE accompanying cuts illustrate the manner in which the principle of centrifugal force is used to automatically oil loose pulleys. The cup will run from one to three weeks per filling, according to the number of starts, stops, speed, etc. All oil put into the cup goes to the bearing and the nuisance of having oil flung and spattered over floor, workmen, machines and belts is entirely done away with, in addition to a decided saving of oil and time effected. Fig. 1 shows the cup ready to screw into the hub of the pulley. Fig. 2 is a view inside, showing the feeding tube.

Fig. 1—Cup ready to screw into hub of loose pulley.

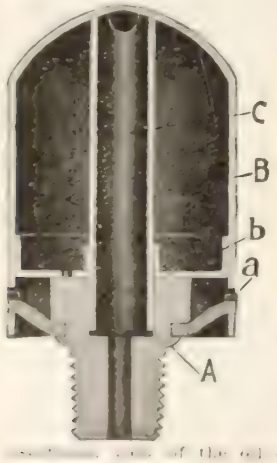


Fig. 2—Sectional view of the oil cup.

When the pulley is brought into operation, the centrifugal force throws the oil to the top of the cup and fills the feeding tube. When the pulley starts next time a portion of the oil in the tube is fed to the bearing, and the tube again fills itself. Fig. 3 shows the cup detached from the nipple for filling. This can be done easily with the hand, no wrenches being required. The cup can be removed, filled and replaced, with the pulley in any position, thus doing away with the necessity of shifting belts, turning shafting, etc., to bring the oil hole on top.

The 20th Century Automatic Loose Pulley Oil Cup is made of thin pressed steel, and is so light that counterbalancing is not necessary. It is, however, amply strong, as there are no moving or wearing parts. The American Specialty Co., Chicago, are the manufacturers.

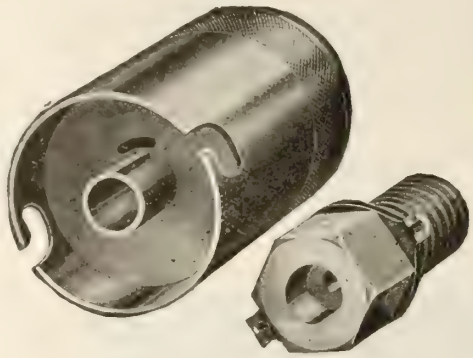
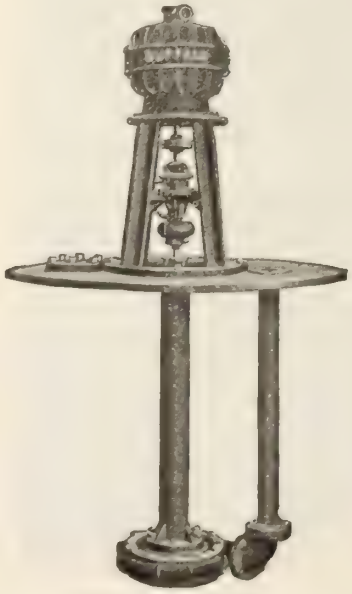


Fig. 3—Cup and nipple as detached for Refilling.

BUFFALO SUMP PUMP.

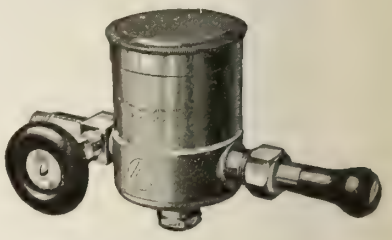
A sump or pit pump that has several interesting details of construction has recently been placed on the market. In providing for positive and copious lubrication of the bearings, a unique method is used. An oil reservoir is bolted oil-tight to the shaft, just below the bearing, and encloses the lower part of the latter. This whirling oil chamber carries the oil by centrifugal force to the inside periphery of the reservoir. Here the oil is picked up by the feed pipe projecting from the lowest part of the bearing. This pipe is bent so that the opening faces against the revolving oil. The speed of rotation develops pressure enough to force the oil to an upper chamber, whence it flows downward over the bearing. A self-aligning, ball-bearing thrust, oiled as above described, carries the weight of the moving parts. The shaft below the cover is enclosed, protecting it from action by sump water and fouling by waste and stringy matter in the sump pit. As will be seen from the cut, all parts of this outfit are easily accessible for inspection. The unit can be lifted from the pit without dismantling, enabling the pit being cleaned out with the least possible trouble. The outfit is entirely self-contained, which makes possible testing of pump and motor at the factory under actual running conditions. When outfit arrives at destination, it needs only to be uncrated, set in the pump pit, electrical connection to the motor and automatic starter made, and the unit is ready for operation.



Buffalo Sump Pump.

DETROIT HAND PUMP.

There has recently been out on the market the hand push pump described and illustrated herewith. A prominent feature is the absence of spring check valves, which more or less are the cause of many pump troubles. Valves with springs are somewhat liable to get out of order, as heat and wear tend to weaken them, and when the springs fail, the pump is useless. In the Detroit pump, care is taken to accurately grind and fit the plungers, so as to avoid leakage.



Detroit Brass Body Push Pump.

The various constructional details are strong, substantial and well finished, being suitable for all services and capable of withstanding the most severe usage. The pumps are made with brass

and glass bodies, and have reversible shank for either vertical or horizontal connection. They may be had also with bodies of brass or glass, and finished in polished brass or nickel-plated. The Detroit Lubricator Co., Detroit, Mich., are the makers.

BUFFALO STRAINERS.

For removing foreign matter from feed water, water supply and similar systems a strainer that differs in many ways from the usual type has recently

Buffalo Strainers

been placed on the market. The development of strainers has been along the line of automatic and semi-automatic types, involving more or less complicated design. The feature of this new strainer, however, is in exactly the opposite direction, and its simplicity can be readily seen by the accompanying cut. It consists of only four parts, the body, basket, top and clamp. To clean the strainer is but the work of two minutes; simply loosen and remove clamp and cover, take out basket and clean under a faucet.

The vital part of every strainer, the basket, is made of fine mesh brass screen, soldered to a brass "former" or top piece, and stiffened both horizontally and vertically, by strong brass strips and bands. It is made unusually large to decrease the resistance offered to the flow of water, the minimum area allowed being fifteen times that of the connecting pipe. This also increases the effectiveness of the strainer and lengthens the time in service before cleaning becomes necessary. If continuous operation is necessary, a by-pass, with or without a second strainer, can be installed.

The Buffalo Forge Co., Buffalo, N Y., are the manufacturers of these specialties and their booklets describe them at some length.

WATER POWER AGAINST STEAM POWER.

It is difficult to estimate the effect of a variable flow, with regard to the limit of variability at which a water-power becomes of no value. "I am firmly convinced," says Charles T. Main, the well-known hydraulic engineer of Boston, "that to-day there are a great many concerns located on streams which are so variable as to require an auxiliary steam plant of a size equal to the water-power plant or nearly so, to whom in the past such water-power may have been a saving, but who now, if they could begin again could produce power more cheaply from a single steam plant than from the double plant.

"It is true that fuel is saved if steam is not required for other purposes than power during such time as the engine is not run; but it is also true that, as the engine is to run only for a portion of the time, it is probably deemed advisable to purchase a low-cost steam plant in order to reduce fixed expense, which means a larger consumption per hour than there would be with a better plant. At times the engine will be unloaded, which is not conducive to economy. To the running expenses must be added the cost of maintenance of a double plant, so that the cost is almost sure to be more than that of a single new efficient plant.

"If the stream is variable, and the water plant the only source of power, which must stop for a portion of the time, it would be of little value under such conditions, except for a limited range of business. No business employing a large amount of labor, carried on in such a way, could compete successfully with concerns which have a continuous run."

Trade Gossip.

The Garlock Packing Co. inform us that their headquarters in Toronto is at 77 Adelaide Street East, and not West, as stated in our June issue.

Owing to the rapid growth and increase of business, the Paul B. Huyette Co., Inc., manufacturers of the "P. B. H." water gauge, "P.H.B." weight gauge cock, and other high grade steam specialities, will remove on or about August 31st from its present quarters in the Betz Building, Philadelphia, to the south-east corner of 18th and Market streets, Philadelphia, where it will occupy the entire third and fourth floors.

R. F. Harrison, Canadian sales manager, for F. Reddaway & Co., belting manufacturers, was married at Lachine, Que., on June 28th, to Miss Lillie E. Morris, of England. Mr. Harrison's many friends in the trade will extend heartiest congratulations to him.

The Vulcan Soot Cleaner Co. recently received an order from an important firm in Georgetown, Demerara, for two of their soot cleaners to be installed on Heine water-tube boilers. This business, they say, came as a direct result of an advt. in "The Power House," and is only one of the many inquiries received by them, which have led to orders from their advertising.

The Wagner Electric Co., with headquarters in St. Louis, Mo., have secured a charter to do business in Canada. It is expected that the firm will start the manufacture of certain of their lines here in the near future to protect some of their important new patents. Alfred Collyer, of Montreal, who has represented this firm for some time as sales agent, will be the manager of sales for Canada.

The Goodyear Tire and Rubber Co., of Canada have found it necessary to increase their plant, and contracts are being let for the buildings, machinery, etc. Special attention has been given to the hose and belt rooms, in which a full new equipment equal to anything on the continent is being installed. Recent orders received are a large rubber conveyor belt contract for the Jenckes Machine Co., Sherbrooke, Que., and a contract for the entire season's requirements of belting, hose and packing from the Dominion Canners, Ltd.

POWER PLANT LAYOUT.

The men's comfort should be kept in view; no man is comfortable in a temperature over 90 deg. F., although many have to work in localities far over this. The ventilation at least should be good, so as to keep the air cool, even although the radiant heat may be excessive. Safety and stop valves, and other fittings should be so arranged, or the surroundings so constructed in the way of ventilation and lagging, that one will not be roasted if called upon to adjust or work them. Ladders should be arranged to give easy access, and when possible should be so placed that the radiant heat from hot bodies should not make them so hot that they cannot be touched. As a rule there should never be less than two ways out, in case any escape of steam or other cause should prevent one being available.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

BRITISH COLUMBIA.

VANCOUVER—Tenders will be received until August 24th, 1911 for the supply of all materials and labor in connection with the installation for the municipality of Penticton, of two 100 KVA., three-phase, 4,600-volt, 900 r.p.m. alternating current generators, direct connected to impulse wheels operating at 2,045 feet effective head; pressure pipe line of about one mile of 10-inch and one mile of 12-inch pipe, switchboards, transformers, meters, distribution and street lighting system. Particulars from F. H. Latimer, C.E., Penticton, B.C.

NEW WESTMINSTER—The Vancouver & Prince Rupert Meat Co. is installing at its new abattoir and meat packing plant, on the Fraser river, a 30-ton, 3-cylinder, double-acting vertical ammonia refrigerating machine, furnished by the Armstrong Machinery Co., Spokane, Wash.

VANCOUVER—P. Burns Co. are having their branch local meat market equipped with a 12-ton refrigerating plant, contract for which was let to the Triumph Ice Machine Co., Cincinnati, O.

SASKATCHEWAN.

MOOSE JAW—Walter J. Francis, C.E., consulting engineer, of Montreal, has submitted his report to the Moose Jaw city council in the question of its water supply.

ONTARIO.

TORONTO—The contract for the refrigerating plant of the new arena rink, Mutual St., Toronto, has been awarded to the Delavergne Refrigeration Co., New York City.

WELLAND—The municipal council are taking the first steps toward purchasing the Welland Electrical Co.'s plant, with the intention of operating it as a municipal institution. The committee have been authorized to secure an expert to place a valuation on the plant. When this information is secured the council will be in a position to take action.

GALT—The water supply of the Hydro-Electric distributing station is insufficient for the cooling of the transformers. The return water from the well raises the temperature of the water to a degree which is not sufficiently cold to do the work required. To overcome this difficulty a four-inch wrought iron main will be laid to a spring 260 feet distant and the water pumped to the coolers.

MIMICO—A special meeting of the Mimico council will be held to consider an offer which has been received from the Hydro-Electric Commission. The offer is to install a local plant, capable of lighting 50 street lamps and 40 private houses, for $7,000, which can be paid for by the village in 30 annual instalments. The load would be from 20 to 25 horse-power, at 2,200 volts, which would be supplied from the sub-station at Cooksville.

ST. CATHARINES—In putting in two more units, with the attendant turbines, generators, etc., the Cataract Power Company is carrying out a work at Power Glen which will cost in the neighborhood of $750,000. It is expected by the company that the first unit will be ready for service about October 1st. This large expenditure has been found necessary to take care of the increased business which is being secured in Hamilton, St. Catharines, Welland and Port Colborne, as well as other places along the company's lines. When completed, the additional horse-power available will reach about 20,000.

QUEBEC.

MONTREAL—The City of Toronto waterworks department recently purchased from the Builders' Foundry Co., Ltd., ten Venturi meters, ranging from 12-in. to 36-in. diameter. These meters are a necessity for the economical control of the water supply, and for the proportioning of the pumping engines in order to obtain the highest duty and greatest efficiency. One of these Venturi meters now in operation in the city of Montreal has a diameter of 36 in. and a range between 30 and 60 million imperial gallons per 24 hours. At present the city is considering the supply of the additional pumps of an average capacity of 42 million Imperial gallons per 24 hours.

MONTREAL—Mr. Lesage, of the water department of Montreal, has reported upon the enlargement of the aqueduct which runs from Point St. Charles to Lachine Rapids. The improvement means that the city will have at its disposal about 100,000,000 gallons of water per day.

MONTREAL—The board of control recently opened tenders for the supply of pumping machinery, cranes and blowers for the water filtration plant to be erected at Point St. Charles. Five were received as follows: Canada Foundry Co., Toronto, $46,700; W. H. Allen & Co., Bedford, Eng., $47,200; John Inglis & Co., Toronto, $49,500; British Electric Plant Co., Alloe, Scotland, $40,250; Daniel Adams & Co., Manchester, Eng., $49,500. The lowest tender is that of the Scotch firm for $40,250, but before making any recommendation the board of control asked the chief engineer and Mr. T. Lesage, superintendent of the waterworks, to report upon the merits of the various tenders. The John McDougall Caledonian Iron Works Co., Ltd., Montreal, put in a tender after twelve o'clock, the time appointed, but Controller Wanklyn informed Mr. Lester, the company's representative, that as it had been received too late it could not be legally considered. It was, therefore, returned unopened.

MONTREAL—Work on the aqueduct at Point St. Charles is now much advanced. Since June 30, the contractors, Messrs. Heeney, Quinlan & Robertson, have extracted 749,000 cubic yards of earth, 84,000 cubic yards of rock, and 2,040 yards of gravel. The work will be finished in October, 1912. The canal is being enlarged to 160 feet at the bottom, 172 feet at the surface, with a depth of 21 feet. This will permit a supply of 100,000 gallons a day being pumped. The city has expropriated 120 acres along the sides of the aqueduct, and a boulevard will be made for a distance of four or five miles from Cote St. Paul to this end of the Lachine canal. The new pumping machinery will cost $400,000; and the total expenditure for the work will approximate $3,000,000.

COATICOOK—The electric light plant came in for some discussion and a resolution was passed at a meeting of the council, to the effect that the electric light committee, together with Alderman McCurdy, be instructed to consult with and engage a competent engineer to install a suitable waste gate at the new dam, and also to advise the cost of remodelling the upper station, and report.

NOVA SCOTIA.

STELLARTON—Work has been commenced on the foundations for the new boiler house at the Allen shafts colliery. This building will exceed in size the large brick building recently erected. The boiler plant will, in a few months, it is expected, consist of six B. & W. boilers of 3,000 h.p., to be followed later by an equal number, making a total of 6,000 h.p. The immense building for electrical power purposes, which is now nearing completion, eclipses even the mammoth steel bank head, and is possibly the largest power building in the province.

New Brunswick.

MONCTON, N.B.—The first shipment of ten-inch steel pipe, to conduct natural gas into Moncton from the Albert gas fields, has arrived at Halifax from England. Ten miles of distributing mains have already been laid in the City of Moncton, and construction work is proceeding rapidly. Street railway construction is also going rapidly forward, and by October the car lines will be in operation and citizens of Moncton will be using natural gas as fuel.

CATALOGUES.

The John McDougall, Caledonian Ironworks Co., Montreal, have issued Bulletin 108, descriptive of the Worthington Turbine Pumps manufactured by them. Illustrations accompanied by text details are given of pumps supplied for the Port Arthur Waterworks; The National Transcontinental Railway; The City of Montreal for their Papineau Ave. Low and High Level Pumping Stations; The City of Lachine, P.Q.; The Ogilvie Flour Mills Co., Montreal; The City of Toronto High Pressure System; The North Shore Power Co., Three Rivers, P.Q.; The City of Lethbridge; The Canadian Copper Co., Copper Cliff, Ont.; The Mond Nickel Co., Victoria Mine, Ont.; The E. B. Eddy Co., Hull, Ont.; The Powell River Paper Co., Powell River, B.C.; The City of Winnipeg; The Chicoutimi Pulp Co., Chicoutimi, P.Q., etc.

H. W. Petrie, Ltd., Toronto, Montreal and Vancouver, have issued a neatly compiled and illustrated booklet, devoted to the Keighley Gas and Oil Engines represented by them in Canada. Bird's eye views of the Keighley Gas and Oil Engine Co.'s Works at Alexandra and Midland, Keighley, Eng., as well as foundry and test room interiors, etc., are shown, and impress one with the idea that quality of manufacture is a prominent feature. Numerous illustrations of different type engines and producer plants are also shown. Petrie, Ltd., are meeting with large sale for these specialties, and those installed and in operation for some time are giving highly satisfactory results.

The Mechanical Rubber Co., Cleveland, O., have issued a handsomely illustrated loose-leaf catalogue D, descriptive of their various lines of packings, gaskets, valves, valve discs, washers, etc. On page D. 1 will be found an article entitled, "A Talk with the Engineer," which is brimful of valuable and wholesome advice to every operator. Throughout the book are to be found tables of steam, hydraulic and refrigeration data, together with pointed paragraphs treating of the daily requirements of the power plant. The catalogue should find a place on every operating engineer's desk, and copies may be had on application by post card.

A clever little folder with some pertinent pointers and facts on "Economical Steam Production" has just been issued by the "Diamond" Power Specialty Company, Detroit, Mich. Any boiler room operator would do well to drop a card to this Company for a copy of this interesting treatise.

The Phenix Lubricator Oil Pump, Square and Round types, is the title of an attractive 16 page catalogue recently issued by the Richardson-Phenix Co., Milwaukee. Besides pointing out the special applications and advantages of the Phenix Force Feed Lubricator for cylinder lubrication on main units and auxiliaries, the proposition of adequately lubricating auxiliaries is discussed at some length. Interesting data concerning different types of power plants show that the rubbing surface and also the power consumption of auxiliaries bear a rather high ratio to the total power output of the plant. The pamphlet points out that it is foolish to spend a lot of money in proper lubrication of main units without devoting some attention to the auxiliaries. Copies of this pamphlet may be had by addressing the Richardson-Phenix Company, Milwaukee, Wis.

The C. A. Dunham Co., Ltd., Toronto, have issued a most artistic catalogue of 67 pages, descriptive of the Dunham Vacuo-Vapor, low pressure, two-pipe system of steam heating. The various features are taken up in detail, and show of what it consists, where it can be used, its principle of operation, its claim to superiority, and its high economy. In addition, the constituent parts are described and illustrated by sectional cuts, the Dunham radiator and blast traps, the Dunham automatic air valve being those to which special attention is directed. A brief history of the development of vacuum steam heating, the results of several service and laboratory tests, together with numerous pictures of public and private buildings in which the Dunham system and apparatus has been installed complete what is undoubtedly a helpful and necessary addition to the reference files of engineers, architects, builders, etc.

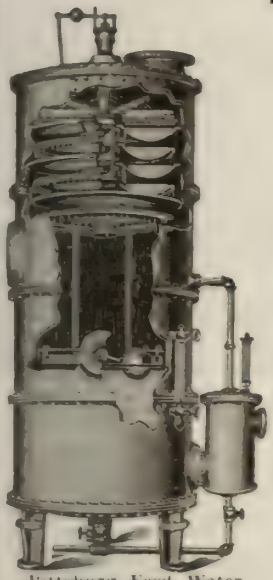
Manzel Bros. Co., Buffalo, N.Y., have issued a booklet descriptive of the Manzel sight feed oil pump for cylinders. Positive and economical lubrication, regularity of feed, ease of adjustment and general convenience are prominent features of this pump, while its adaptation is such as to cover the field of Corliss and high-speed engines, steam pumps, etc.

The Sterling Blower Co., Hartford, Conn., have issued a 12-page catalogue covering their slow-speed, low-power, steel plate exhausters. Provision is made for driving by belt, motor, turbine or engine. The designs illustrated and described show single and double types, with self-aligning bearings, ring-oiled and babbitted.

"The Spontaneous Combustion of Coal, with Special Reference to Bituminous Coals of the Illinois Type," by S. W. Parr and F. W.

A COMPLETE LINE OF TROUBLE SAVERS

JUST WHAT YOU NEED IN YOUR PLANT

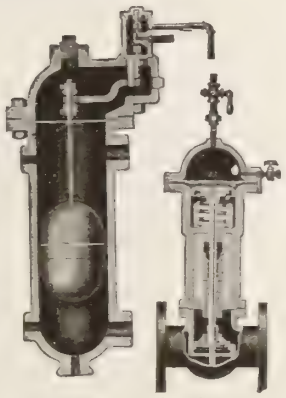


Pittsburg Feed Water Heater.

The First Cost of the Pittsburgh Feed Water Heater is the Last Cost.

1,500,000 H.P. IN USE

Liberty Feed Water Regulators prevent accidents. Can be adjusted under full pressure. Maintain a constant level.

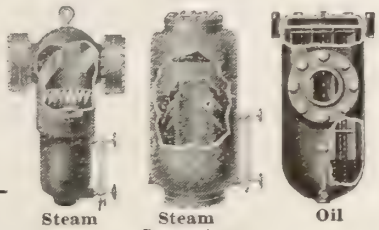


Liberty Feed Water Regulator.

Liberty-Greenaway Separators utilize Gravity.

They are for Air, Ammonia, Oil or Steam.

The Separators that SEPARATE.



Steam Steam Separators. Oil

Reducing Valve.

Elliott Reducing Valves have no Springs, Weighted Levers or Diaphragms.

Have few working parts.

A Combined Safety and Reducing Valve.

Steam Trap.

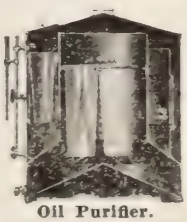
Elliott Steam Traps discharge the water at atmospheric pressure. Have but one wearing part—The Valve.

Blow-Off Valve

The Faber Blow-Off Valve washes its own face. A steam jet cleans the seat—consequently it does not leak.

Liberty Oil Purifiers remove ALL the dirt, ALL THE TIME.

No Sawdust, Wool, Waste or other troublesome filtering material used.



Oil Purifier.

Twin Strainer.

The Twin Strainer protects your Pumps, Boilers and Condensers from foreign substances found in the water supply.

Built in all sizes, for all pressures. One side works while the other is being cleaned.

Write to-day for bulletins of the device you are interested in. Don't delay.

REMEMBER IT'S

ELLIOTT COMPANY

6902 Susquehanna Street - - PITTSBURGH, PA., U.S.A.

[illegible] has just been issued as Bulletin No. [illegible] of the Engineering Experiment Station of the University of Illinois. The bulletin describes a series of experiments directed toward the determination of the fundamental causes underlying the spontaneous combustibility of coal. These causes may be summarized as follows: (1) External sources of heat, such as contact with steam pipes, hot walls, and the impact of large masses in the process of unloading, height of the piles, etc.; (2) fineness of division; (3) moisture; (4) activity of oxidizable compounds, such as iron pyrites. An historical review of the literature upon the spontaneous combustion of coal is given in the appendix. Copies of this bulletin may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

HAND TACHOMETER—Paper, 6x7 ins., 4 pp., Schuchardt & Schutte, 90 West St., New York. This new hand tachometer is a more universal instrument than the previous one placed on the market. It is now a combined hand tachometer and cutmeter which is equally convenient for indicating rotative speed as well as progressive speed and is used without a stop watch.

BUREAU OF MINES, WASHINGTON, D.C. —The results of investigations into the briquetting of lignite have just been published by the Bureau of Mines in bulletin No. 14. Charles L. Wright, who conducted the tests and who is author of the bulletin, declares that enough testing has been done to indicate that some American lignites equal German lignites in fuel value, and can probably be made into briquets on a commercial scale without the use of binding materials. This bulletin can be obtained by those interested by writing to the Diretcor of the Bureau of Mines, Washington, D.C.

BUREAU OF MINES, WASHINGTON, D.C. —In connection with its investigations bearing upon the improvement of furnace conditions and on efficiency in the use of fuel, the Bureau of Mines has just issued a bulletin describing the apparatus and methods in use by the Bureau, for the sampling and analysis of furnace gases. This bulletin, which is No. 12, may be obtained by those interested by writing to the Director of the Bureau of Mines, Washington, D.C.

BUREAU OF MINES, WASHINGTON, D.C. —"The Escape of Gas from Coal" is the title of technical paper No. 2 just issued by the Bureau of Mines. Those interested may obtain copies of this technical paper by applying to the Director of the Bureau of Mines, Washington, D.C.

FEED WATER HEATER—The Stewart Heater Co., Buffalo, N.Y., have issued a booklet of illustrative and descriptive matter pertaining to the various types of Otis tubular feed water heaters, combined with oil separator and purifier. These are made for either exhaust or live steam in vertical or horizontal form. The heater body is of steel or iron boiler plate, riveted at the top end to a heavy cast iron ring, with prejecting rim cast on its outer surface, forming a flange, to which the tube sheet and top dividing plate is attached by one row of bolts. The lower end of shell is riveted to a heavy cast iron conical bottom, and which is in the case of the vertical type supported by four legs, forming a substantial base. The tubes are of seamless brass. Prominent among the features claimed for these heaters is the facility with which they can be cleaned, the certainty of precipitation of impurities in the heater before the water enters the boilers, the absence of back pressure, the fact that each tube may expand independently of the others, the extraction of the oil, the separation of the water of condensation and means for carrying it off. With one square foot heating surface per horse-power used water at boiling point is guaranteed from exhaust steam.

VULCAN SOOT CLEANER—A booklet received from the Vulcan Tube Cleaning Systems, Ltd., 204 St. James St., Montreal, gives testimonial letters telling "what users are saying about the Vulcan soot cleaner."

SPRAY NOZZLES—The Buffalo Forge Co., New York, have issued a booklet describing their spray nozzles and strainers. They cover such purposes as mine washing, gas washing, condensing plants, chemical plants, etc. The text and illustrations show their construction and detail their operation.

TRANSFORMERS.—The Crocker-Wheeler Co., Ampere, N.J., has issued a booklet containing transformer data, in which is included a table showing the comparative efficiencies of the leading transformers made. The process of manufacturing the Remek transformer is described at length.

PACKING—The Garlock Packing Co., Hamilton, Ont., specialists in engine packings, have issued a new catalogue of 77 pages, 4½x8 ins. Among the packings, gaskets, etc., catalogued, are ring packing, spiral, diagonal, odd shape ring asbesto-metallic, ammonia, valve stem twist, air-compressor, air pump, locomotive throttle, gum core, square flax, hydraulic and duck packings; valve discs, asbestos wick and rope, sheet packing, gaskets, gauge glasses, belting, belt lacing, grease, graphite, tube cleaners, etc. As prices are included, the catalogue is a valuable one to engineers and should be included in their catalogue files.

Crucible furnaces in which coke or coal is burned should be repaired at frequent intervals in order to prevent the burning out of the body of the furnace. The fire-brick, burning out around the body of the furnace, increases its capacity and a larger quantity of coal than should be used is taken. For this reason it is not economical to allow furnaces to go too long without repairing. The fuel consumption will then become too large.

GIFFORD TRAPS

Return, Lifting & Vacuum

The Newest & the Best

also

The Least Expensive.

Write for Particulars.

Percival F. Gifford

505 Power Building MONTREAL

"KELVIN" BOILER COMPOSITION

Do you use Boiler Compositions? If not, investigate your boilers, as experience has proven that all boilers have a certain amount of scale. Every particle of scale decreases your boiler efficiency and increases your fuel bills. Kelvin Boiler Composition is guaranteed to remove all scale from any type of boiler without the slightest harm to plates or metals.

Kelvin Boiler Composition is supplied to all the mines of the Consolidated Gold Fields of South Africa, on a 5-year contract, also to The Dill, Russell & Chambers Co., contractors for the Filtration Plant, Centre Island, Toronto, etc.

To further advertise this reliable scale killer we solicit a **30-DAY FREE TRIAL ORDER.** If this composition doesn't prove a money-saver return it at our expense.

Wm. Cooper & Nephews,
Toronto.

Gentlemen:—
Some time since you sold us a quantity of "Kelvin" Boiler Composition. We liked it so well that I will ask you to send forward, addressed to this company, $15.00 worth, and you may make a sight draft for the amount.

Yours very truly,
E. V. TILLSSON, Mgr.

Wm. Cooper & Nephews, Toronto, Ont.

Engineers, Machinists and Draughtsmen

THE ART METROPOLE LIMITED 149 YONGE STREET TORONTO ARTISTS' AND DRAUGHTSMENS' MATERIALS

Will find a full and select line of Drawing Instruments and Supplies at the leading house in Canada

THE ART METROPOLE, Limited
149 YONGE ST., TORONTO

Notice to Stationary Engineers

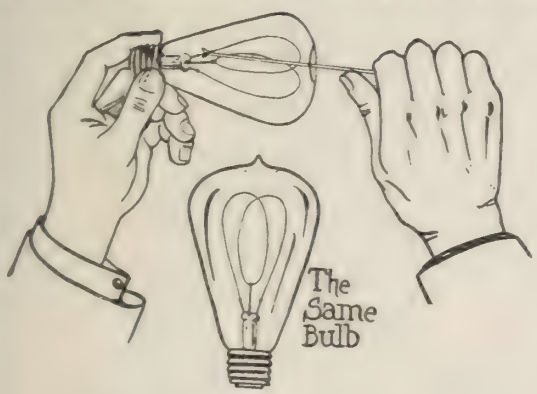
Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

Save Time and Money by Buying

REFILLED LAMPS



Why continue the unnecessary expense of buying new incandescent lamps?

We can furnish you with refilled lamps that are—not surpassed in quality or durability by the best new lamps made, at a reduction in price that is surprising to everybody.

WRITE FOR PRICES.

The Dominion Electric Co.
ST. CATHARINES, ONTARIO

VALVE DISCS

from the wonderful new material

'Bakelite'

"BAKELITE" has sounded the doom of valve discs of every other material, and for the following important reasons:

"BAKELITE" Discs can be used universally for cold water, wet or dry steam, superheated steam and chemicals.

"BAKELITE" Discs are made under high temperature and will, therefore, meet the conditions of high temperature service. They are affected by absolutely nothing except careless handling and friction, having great strength and hardness. They stand excessive wear and can, when necessary, be reground and refaced, always retaining a uniform surface.

"BAKELITE" Discs are a boon to valves which are constantly giving trouble owing to the use of special liquids, high pressure and high temperature—they cannot become soft.

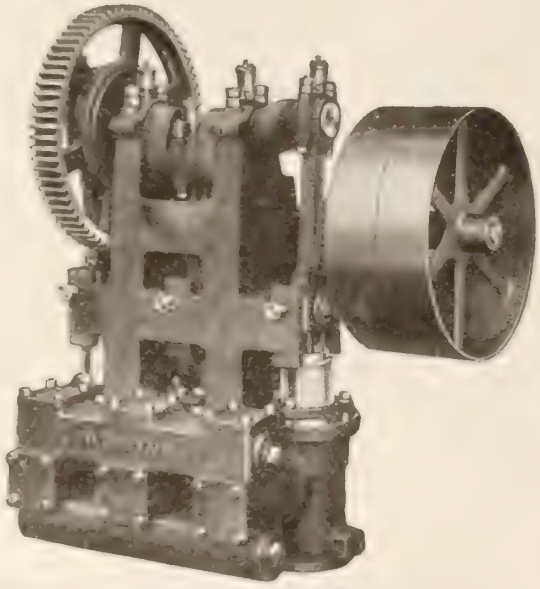
Do not use high priced special metal discs when "Bakelite" is *better* and *costs less money.*

Order "BAKELITE" Discs from your dealer and use them anywhere in the plant. You will never use anything but "BAKELITE" Discs when you have once tested them. They mark a new era in valve efficiency.

Write us direct if your dealer hasn't them

PLASTICS Limited
148 Van Horne St. - Toronto

DEMING POWER PUMPS
NECESSARY IN POWER PLANTS



Belt Driven Deming Triplex Power Pump. For boiler feeding, tank service, general water supply, etc. Can be direct-connected to motor.

Not only in the "long run" have Deming Pumps demonstrated their money saving qualities—but right from the start they have "delivered the goods," and in factories where "Scientific Management" is practised, there you will find Deming Power Pumps.

If you need a pump in your factory, you need our Catalogue. Tell us what you want the pump to do.

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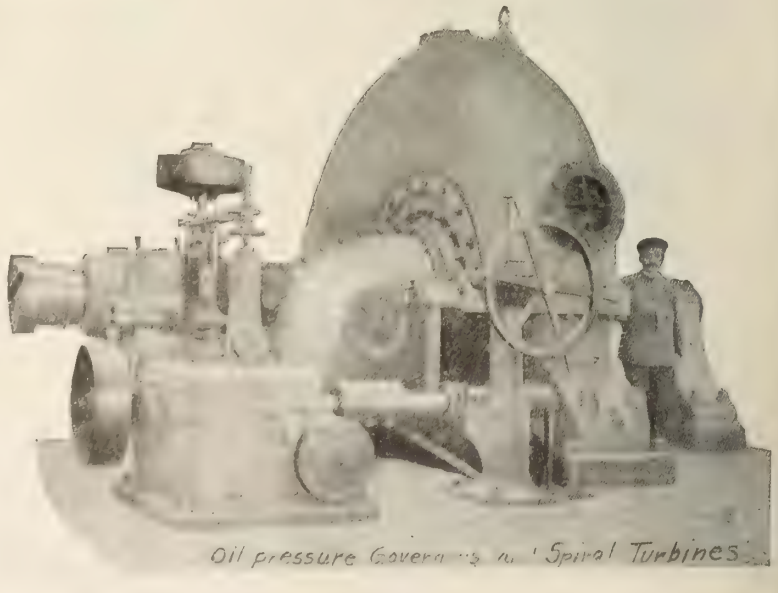

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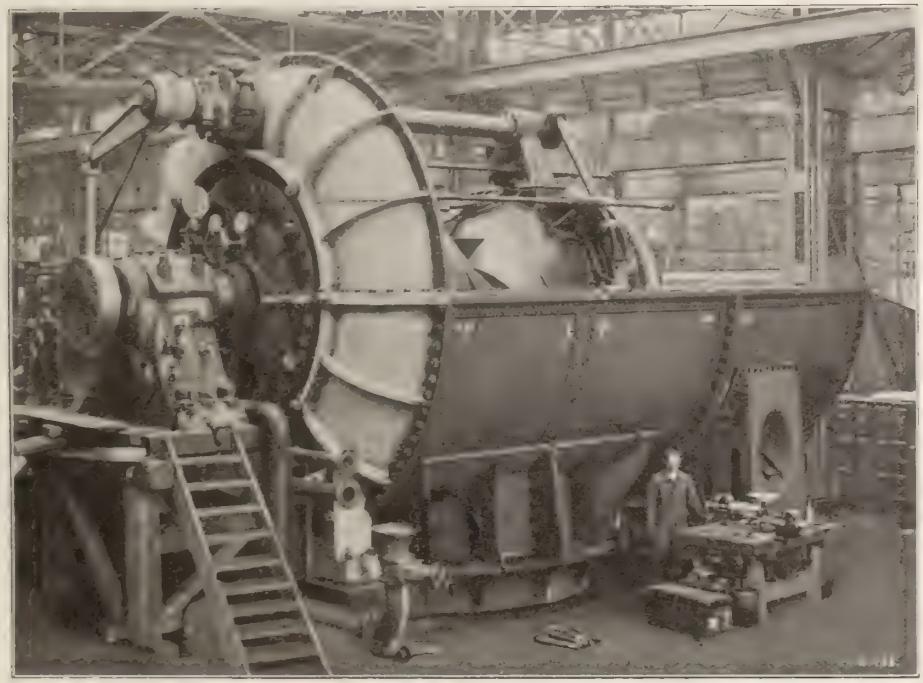

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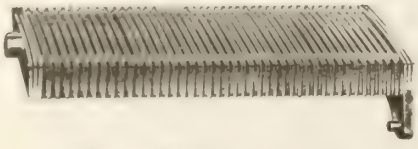

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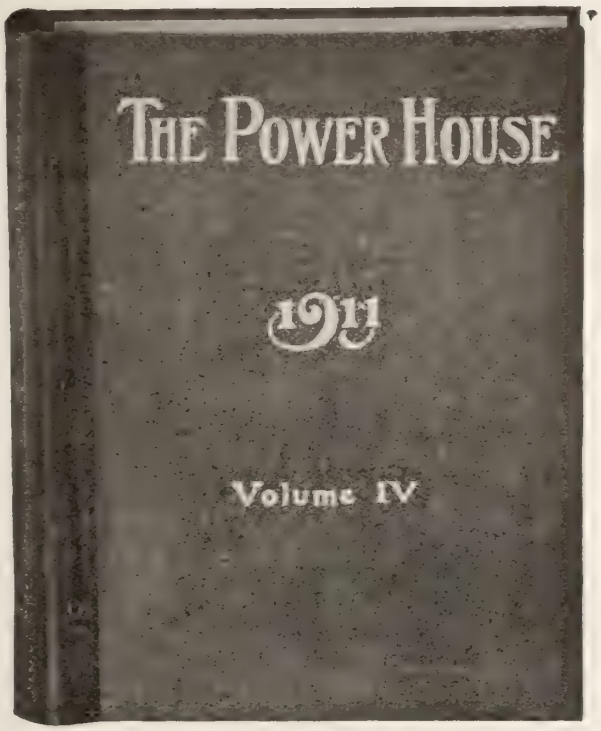

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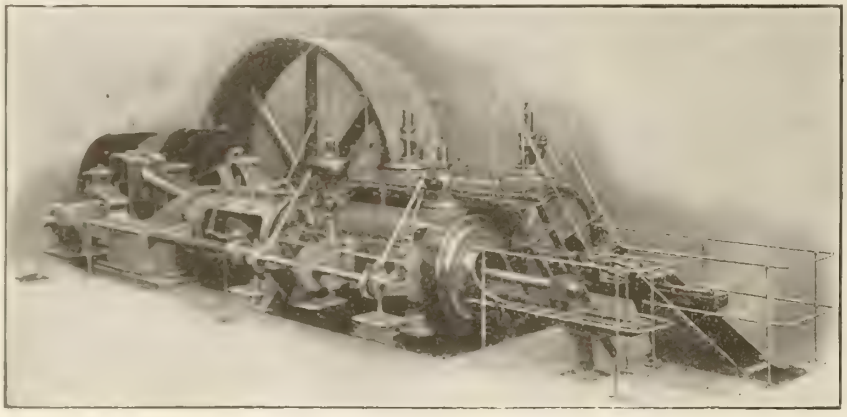

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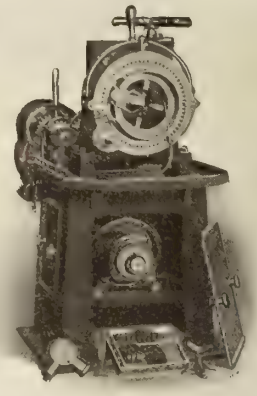

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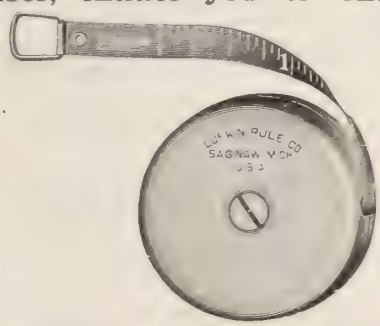

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Will increase your fuel bills and ruin your boiler

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will eliminate all such dangers by keeping the tubes and plates absolutely free from scale. Dearborn Treatment makes every shovelful of coal yield its utmost value. Dearborn Treatment also prevents corrosion and all other boiler troubles due to impurities in the feed water.

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No new scale can form in any boiler in which "Eclipse" is correctly used.

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In "Eclipse" Boiler Enamel we have a preparation which gives no heed to the class of water used, but in every case puts a filmy coating over the heating surfaces of the boiler, which makes it absolutely impossible for solid matter in any form to adhere to the iron. The scale-forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler in the form of a soft, soapy mud which will not burn or blister, and is most readily blown from the boiler.

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Write at once and LET THE USER CONVINCE YOU before you buy. His testimonial will be a great advertisement to us.

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"Eclipse" Boiler Enamel is guaranteed to be absolutely harmless to the boilers or the fittings. Being harmless, it is slow in its action on old scale, but it is deadly sure.

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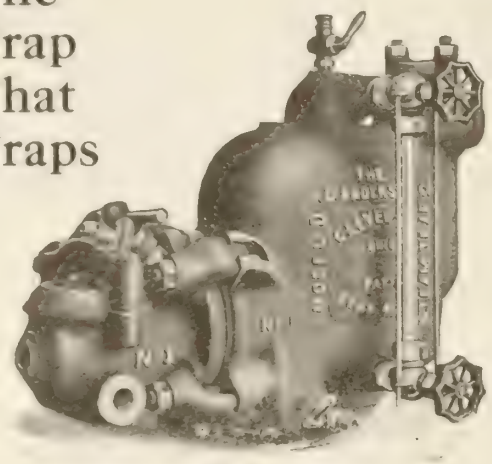
Discharges the Water AND Holds the Steam

The Trap That Traps



It is all that its name implies---a trap for steam from which steam **never** escapes, and water of condensation **invariably does.**

The body is constructed of close grained iron, with a valve which can be removed without disconnecting trap from pipes.

The valve and valve seat, of phosphor bronze, are simple in construction and easy of access.

The Anderson will deliver exhaust water against any back pressure of five pounds less than the steam pressure at the trap.

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O, your deserts speak loud;
And I should wrong it,
To lock it in the wards of covert bosom.
Measure for Measure.

HOW TRUE IT IS that where deserts speak loud, it is an injustice not to acknowledge it. The deserts of

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BEARING METAL are acknowledged from Coast to Coast. The following reasons have made it our MOST POPULAR SELLER:

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It is a high grade Babbitt at a medium price.

OUR GUARANTEE IS BACK OF EVERY POUND. *WRITE FOR PRICES.*

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The "P.B.H." QUICK CLOSING WATER GAUGE is the best-known insurance against scalds and burns. If the glass breaks a pull of the chain shuts off both steam and water instantly. It is made of selected metal, and is strong and durable.

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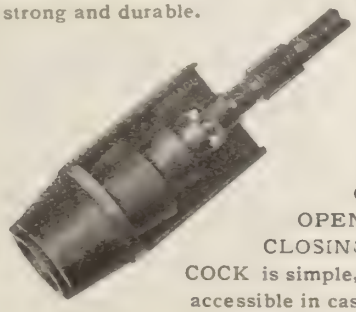

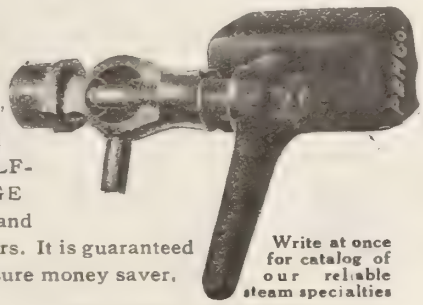

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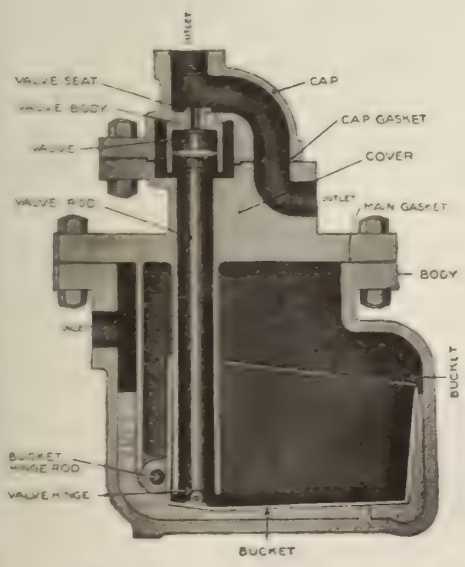
Here is What it is Worth to You To Be Able to Test the Valve In Your Steam Traps Without Time or Trouble.



If the valves in your steam traps are leaking steam, and they probably are; if you have to take the time and trouble to take the trap apart to get at the valve, and the leak is 1/8 in. and your pressure 75 lbs., you are saying good-bye to at least 275 lbs. of coal every 9 hours. Why don't you buy

Strong Steam Traps

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We can give you this cup in buff finish or satin finish as you prefer. Do not hesitate to ask for prices or samples.

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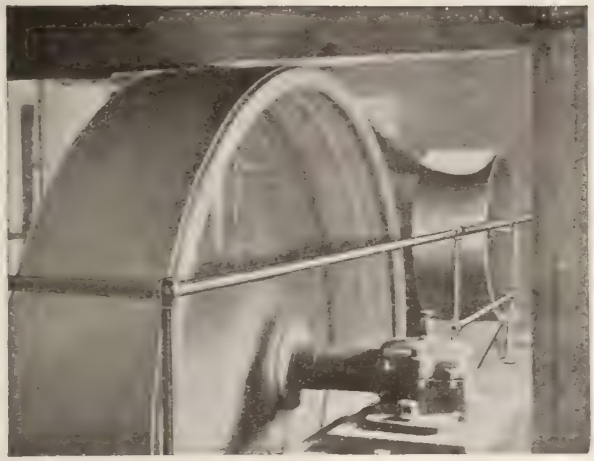

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WE WILL GLADLY FURNISH ENOUGH DRESSING FOR A FAIR TRIAL

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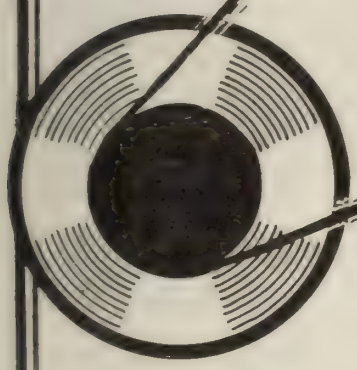
UNDIMINISHED POWER

IS THE GREAT REQUIREMENT FOR THE IDEAL BELTING



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Genuine British Oak-Tanned

LEATHER BELTING

can be absolutely relied upon to transmit the maximum of power with certainty. It will compare favorably with any belting on the market in durability and wear resistance; will not stretch or bend, and is in every way just what you need in your plant.

McLaren's Belting is tanned by the genuine, proven Oak Bark method; only the best of close trimmed hides being used.

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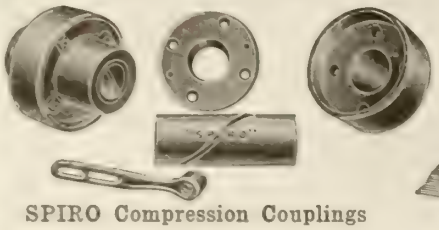

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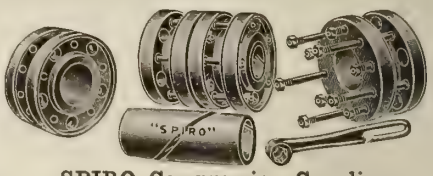
Make Your Assurance
"DOUBLE SURE"
and Take a Bond.



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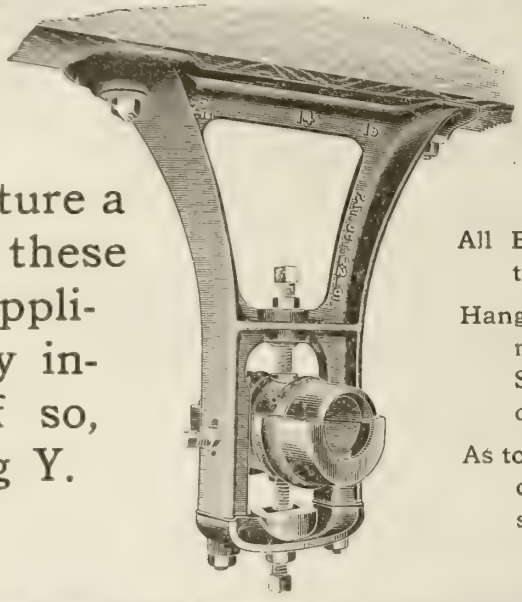

We manufacture a complete line of these Transmission Appliances. Do they interest You? If so, write for catalog Y.

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All Bearings REAMED accurately to shaft size.

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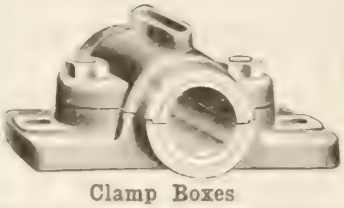

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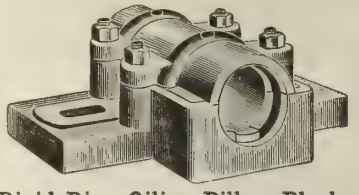

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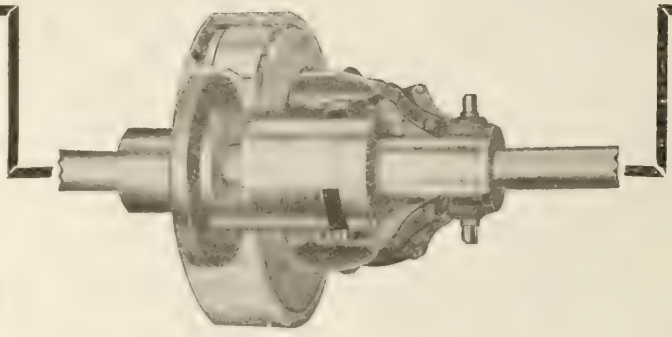

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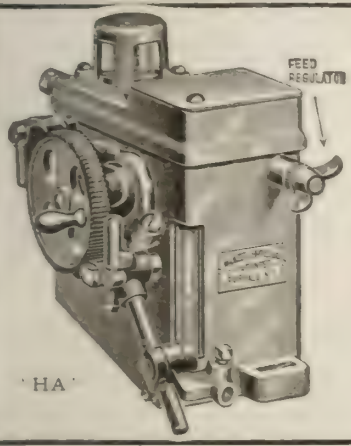

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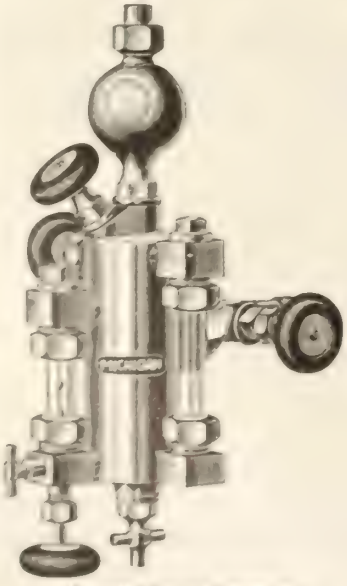

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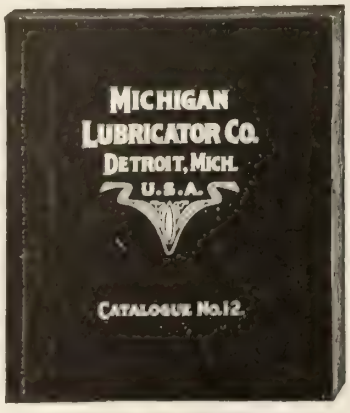

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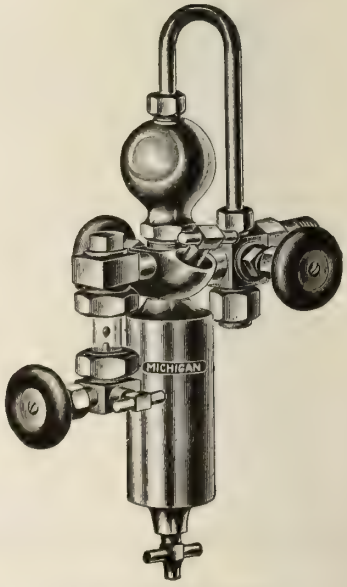

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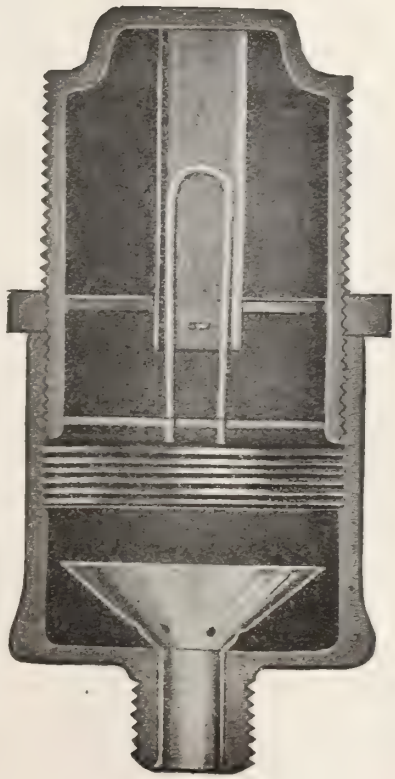

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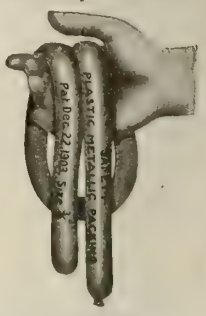

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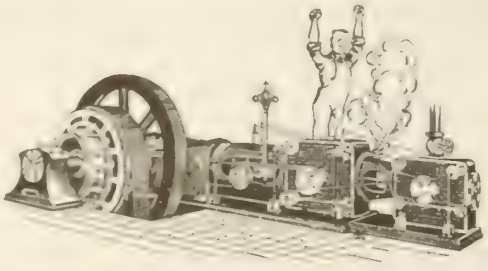

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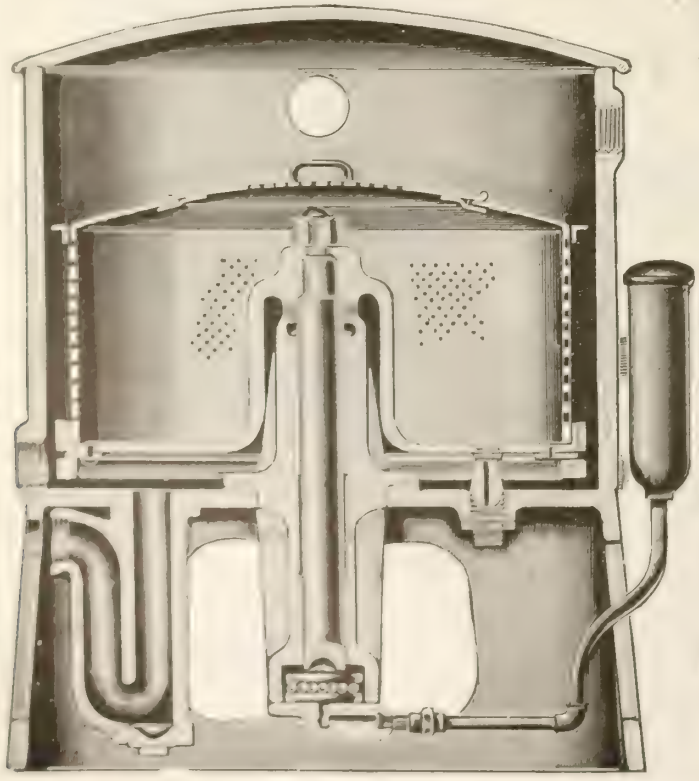

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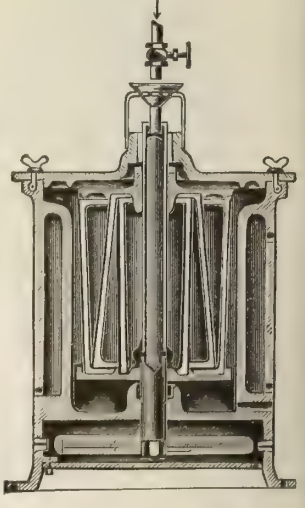

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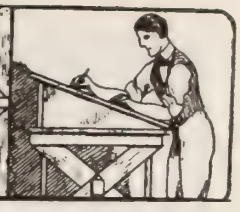

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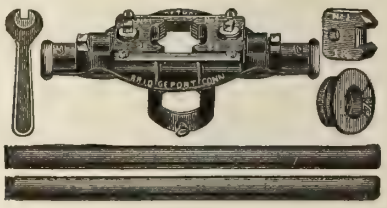

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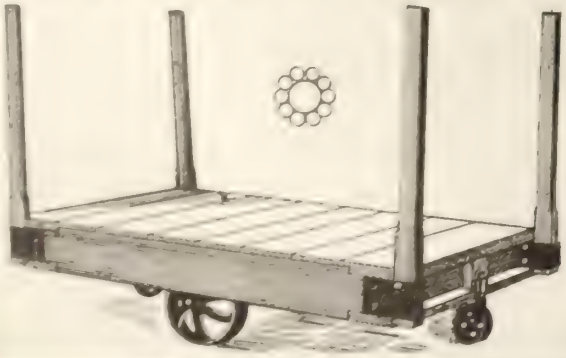

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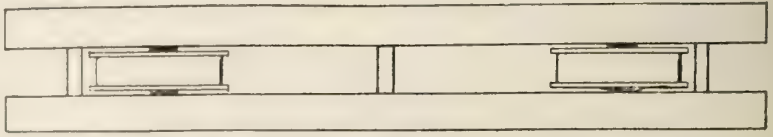

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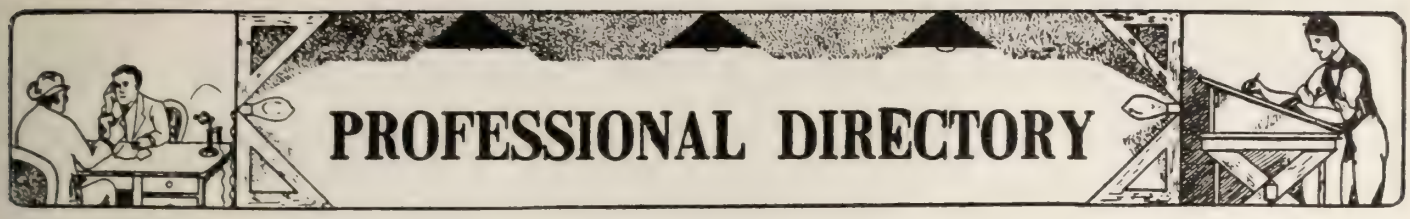

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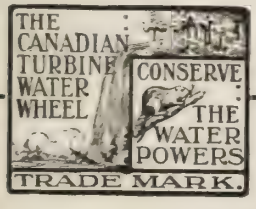

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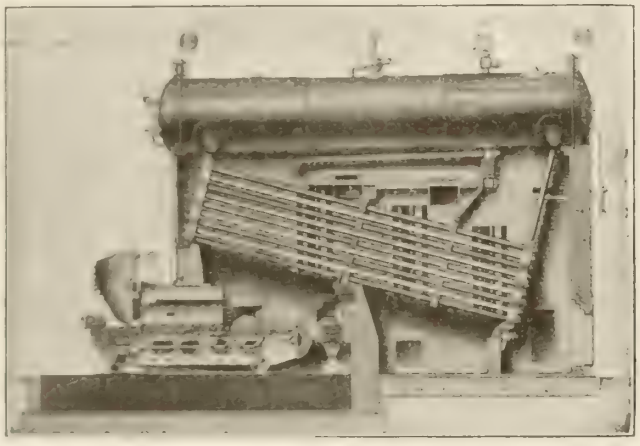

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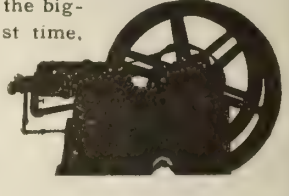

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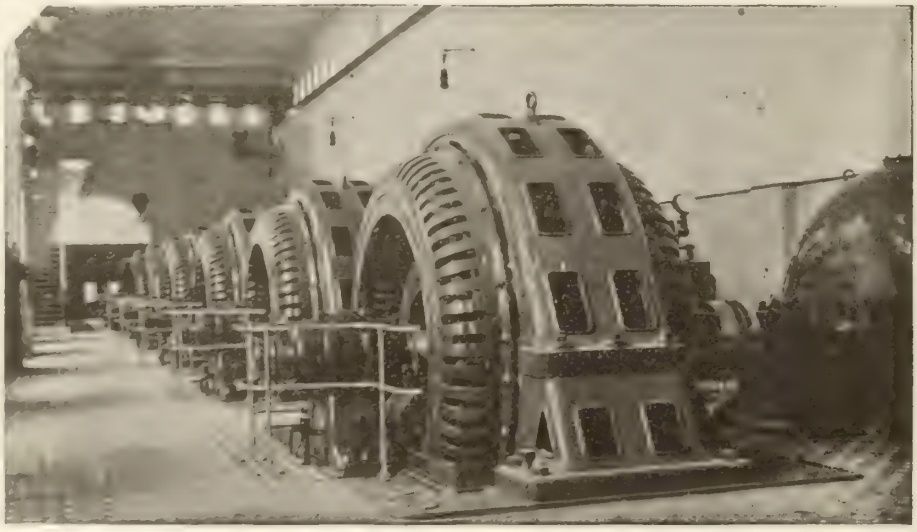

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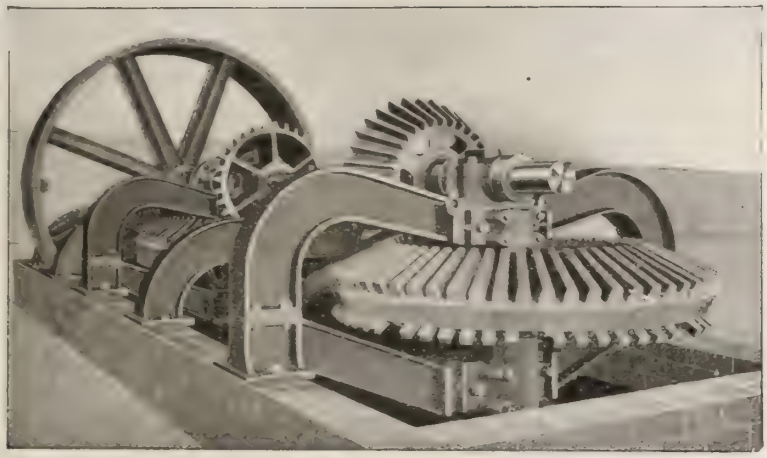

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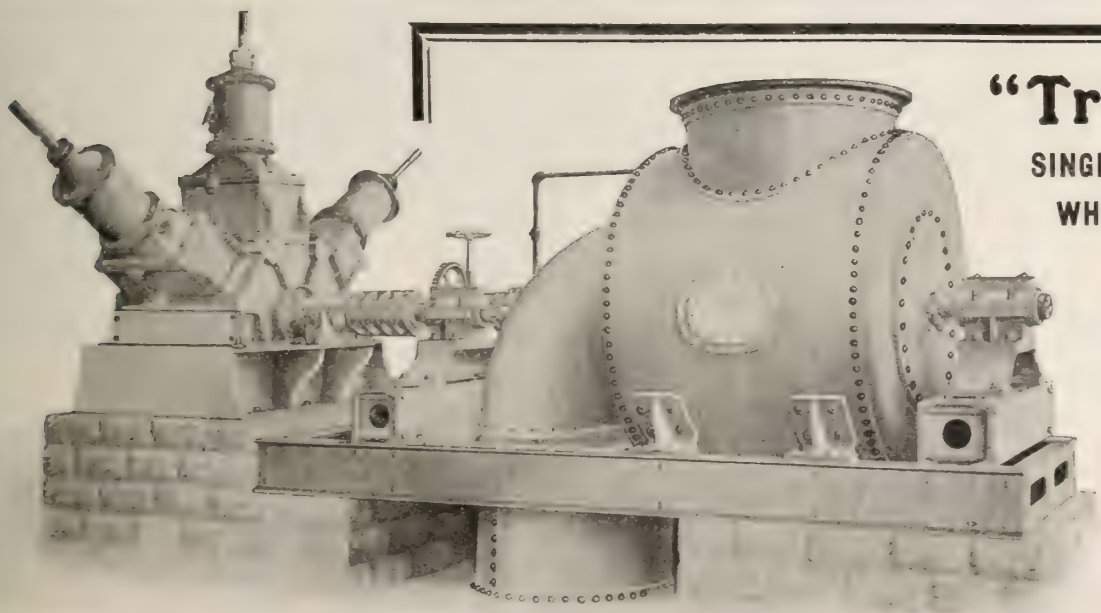

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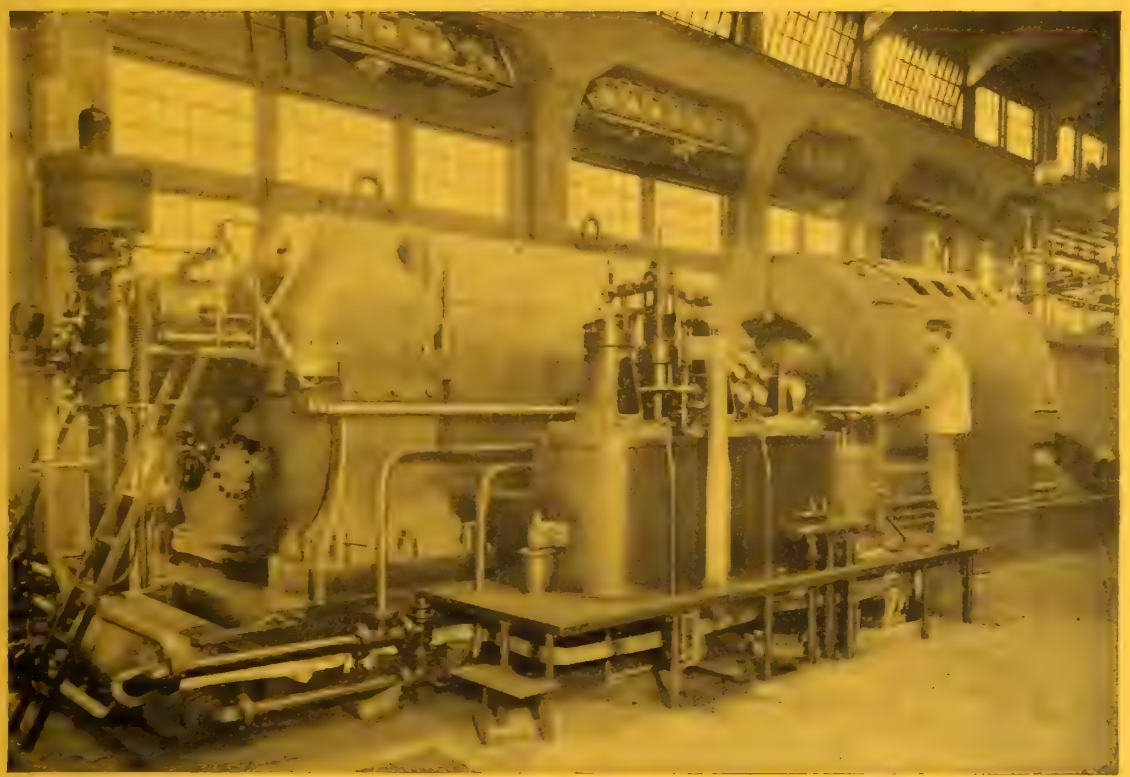

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"The Liquid Lifter"

THE MOST SIMPLY CONSTRUCTED, THE EASIEST OPERATED AND THE MOST SATISFACTORY JET PUMP OR SYPHON ON THE MARKET

The illustration at the left shows the best method of priming centrifugal pumps. A Penberthy "XL-96" Ejector is attached to top of the pump as shown; this, when operated, produces a partial vacuum in the pump and its suction pipe, permitting the water to rise into the pump.

When the "XL-96" Ejector is connected with the suction attached to the pump it can be operated with air, steam or water—air being preferable because of its exhausting larger quantities in a shorter time.

The "XL-96" Ejector will, with a smaller steam consumption, lift more water from a greater depth and deliver it at a lower temperature than any other syphon or steam jet pump. It will lift 22 to 25 feet and elevate 25 to 100 feet on from 30 to 100 lbs. pressure. For high elevations we recommend placing the ejectors as illustrated on the right.

THE PENBERTHY "XL-96" EJECTOR

can be used to advantage wherever water or other liquids have to be elevated or transferred from one receptacle to another—for draining flooded cellars, fly wheel pits, sumps, emptying stopped up sewers, drains, etc.

Write us for complete descriptive matter and advice regarding your conditions

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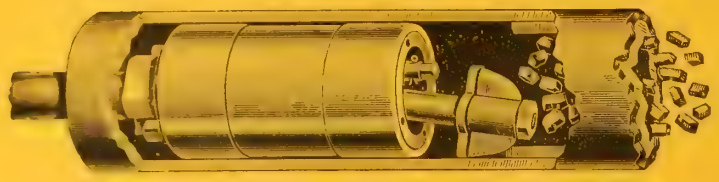
Penberthy Injector Co., Limited - Windsor, Ont.

The Trend of New Thought

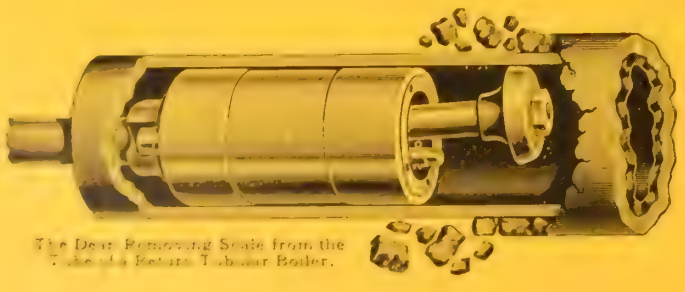


The Dean Removing Scale from the Tube of a Water Tube Boiler

The Dean is upsetting old theories about boiler cleaning. Everybody formerly had the compound habit. Faith in compounds was almost universal. 'Twasn't an opinion founded on facts, but a habit of the mind. Then the Dean came. Lots of engineers tried it, more out of curiosity than because of any faith in it. They discovered to their surprise that the Dean could get anywheres from 300 to 800 pounds of scale from a compound-cleaned boiler. They saw they could save coal for their employers and get better steaming from their boilers by its use. They learned that by periodical use of the Dean, they could keep their boilers clean—and they stopped paying tribute to the compound man. The trend of new thought is towards

THE DEAN BOILER TUBE CLEANER

It has won out not because of promises we made of what it would do, but because of results actually accomplished. We have never asked a man to buy promises. We have been selling results. We say to a man: Here's the Dean, try it in one of your boilers, and see what happens. And what happens? About 99 times out of a hundred the Dean sticks, and for no other reason than that it surprises and satisfies the man who tries it. The reason why you don't use a Dean is that you haven't tried it.



The Dean Removing Scale from the Tube of a Return Tubular Boiler.

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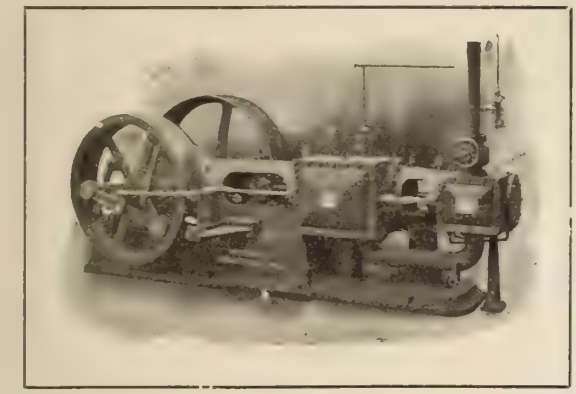

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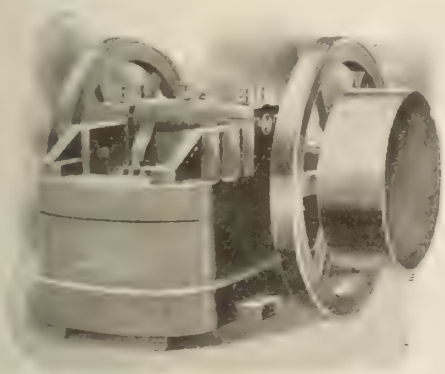

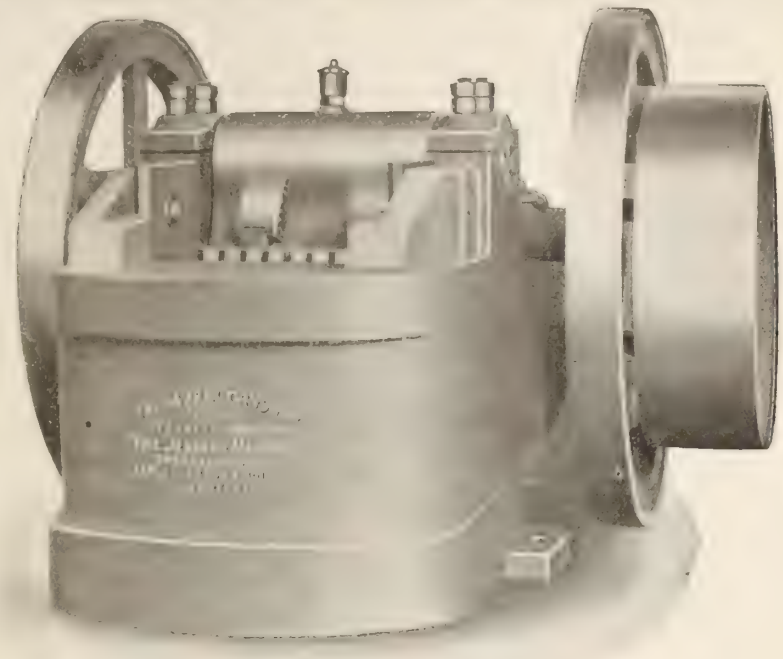

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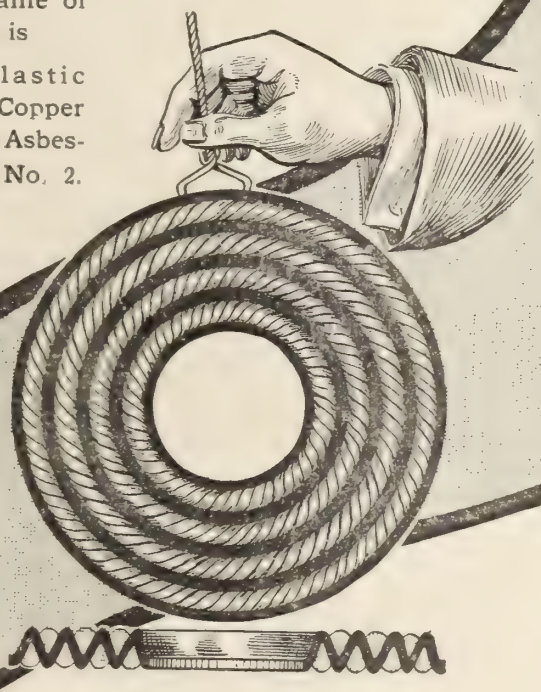

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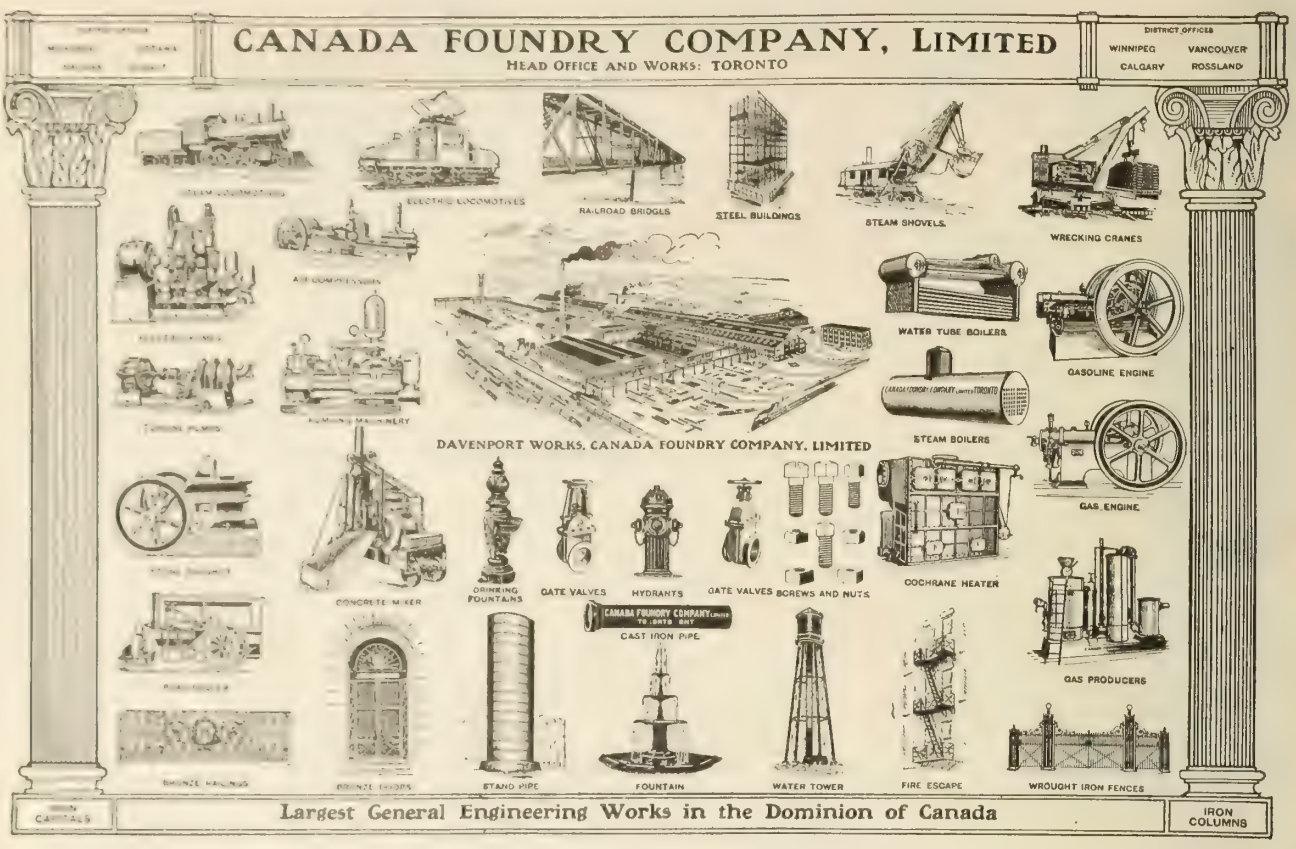

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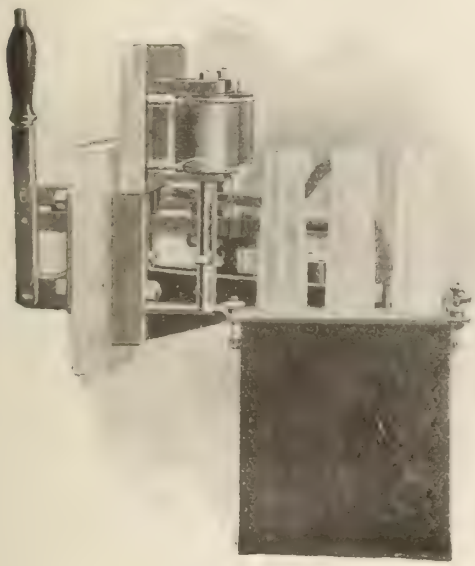

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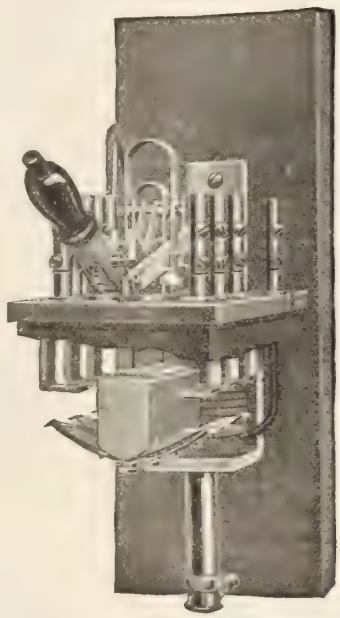

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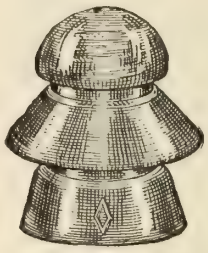
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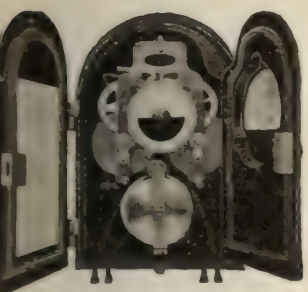

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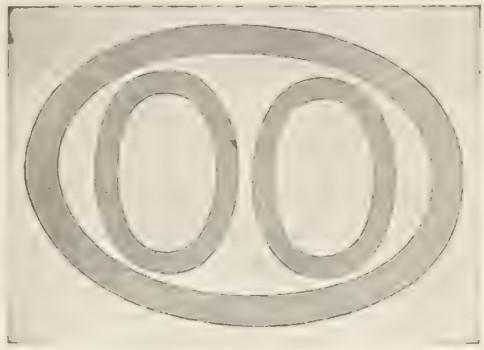

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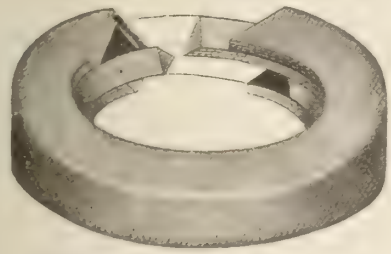

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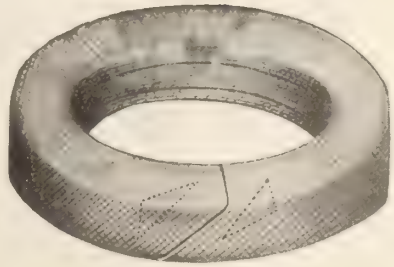

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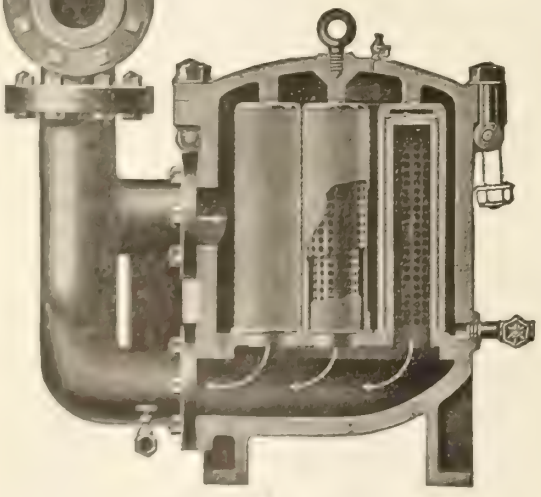

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Boiler Tube Cleaner

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The CRISS CROSS Cleaner is guaranteed to remove scale without the slightest injury to the boiler, and to save from 10% to 15% in cost of power production.

Its use means increased boiler efficiency.

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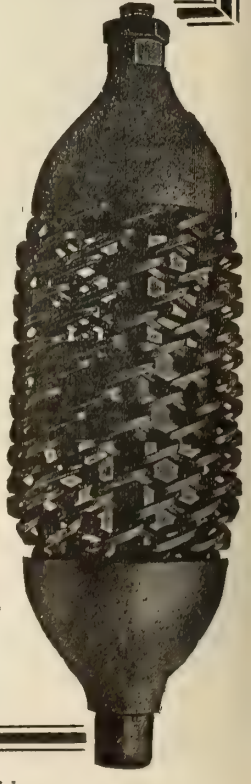

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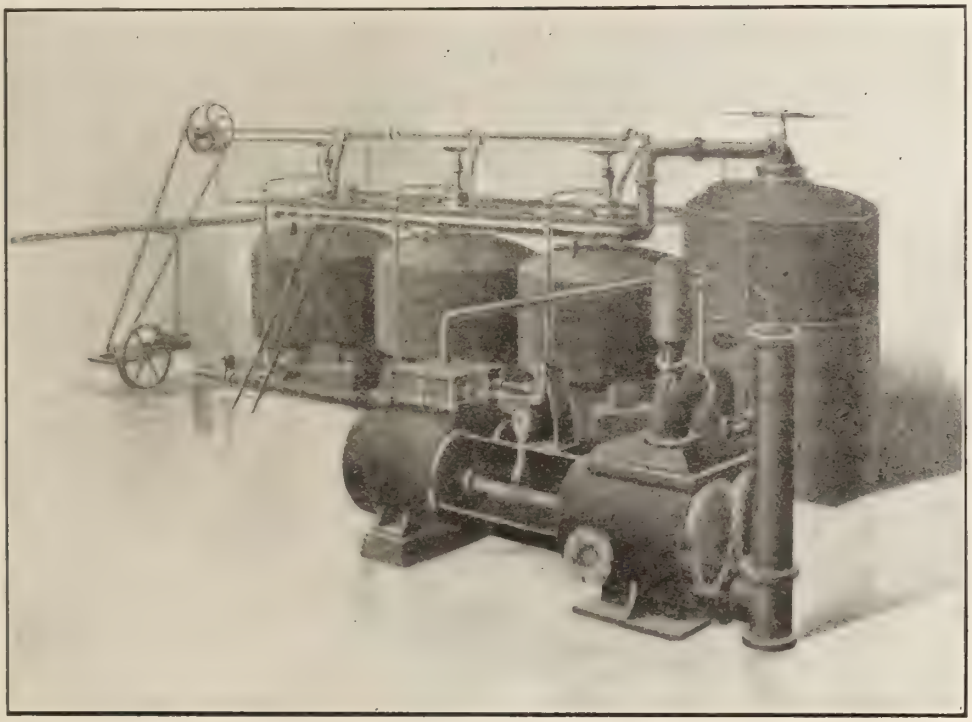
For Boiler Feed and Manufacturing Purposes



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CONFORM WITH THE NEW CANADIAN BOILER REGULATIONS AND ARE APPROVED FOR USE IN WESTERN CANADIAN PROVINCES, INCLUDING BRITISH COLUMBIA, ALBERTA AND SASKATCHEWAN.

THE LINE APPROVED INCLUDES GLOBE, ANGLE, CROSS, GATE, BLOW-OFF AND POP-SAFETY VALVES, WATER GAUGES, GAUGE COCKS, ETC.

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THE SUPREMACY OF **LUNKENHEIMER PRODUCTS** IS UNIVERSALLY ACKNOWLEDGED, AND TO MAINTAIN THIS REPUTATION, THE HIGHEST TYPE OF SKILLED LABOR IS EMPLOYED AND ONLY NEW MATERIAL OF THE VERY BEST GRADE IS USED.

WE GUARANTEE OUR GOODS TO BE OF THE VERY HIGHEST QUALITY, AND A **LUNKENHEIMER GUARANTEE** IS A REAL, DEFINITE QUANTITY AND NOT AN EMPTY USE OF THE MEANING OF A GUARANTEE.

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FULLWAY VALVES.

OPENS CLEAR TO FULL CAPACITY OF PIPE

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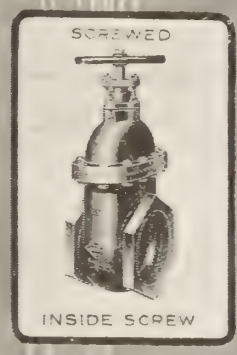

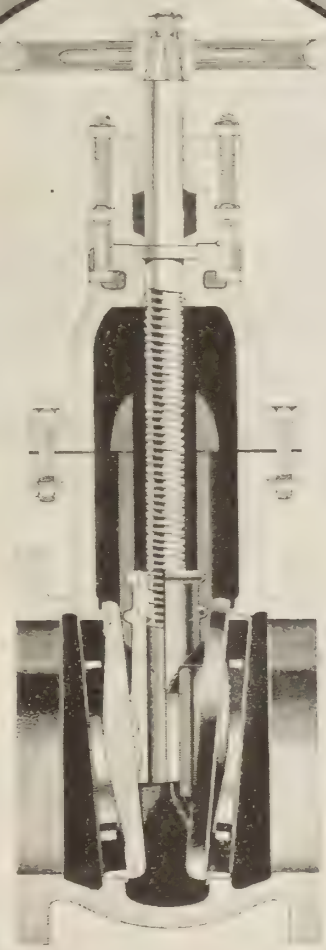

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GATES CAN NEITHER JAM NOR CHATTER

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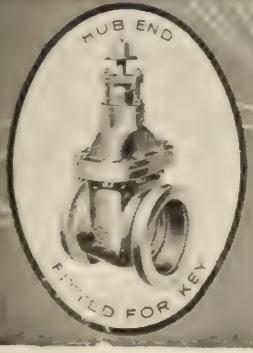

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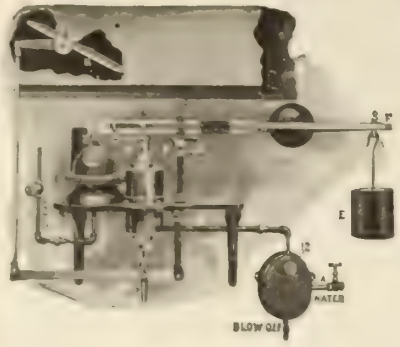

WITH A

Stillman-Carmichael Damper Regulator.

The SAVING effected in FUEL by the installation of this Regulator will vary from 5 to 18% and the first cost is very small.

It will REGULATE High and Low pressure STEAM BOILERS, Blowers and Pumping Engines.

One Regulator will govern one or more Boilers. It will close or open wide the damper or dampers on a variation of ONE POUND of STEAM.

We furnish these Regulators subject to 30 days' trial.

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STRAIGHTWAY VALVES

ALWAYS OUTLAST
OTHER VALVES

For Pressure Up to
5000 lbs. Per Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details.

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Homestead Valve Mfg. Co.

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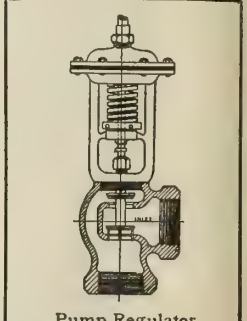
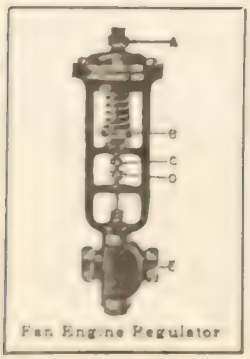


Pump Regulator



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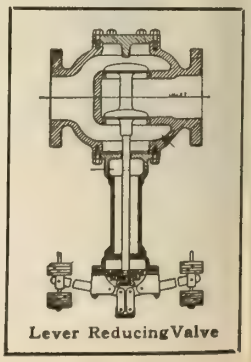


Lever Reducing Valve

There are Three—*only three*—working parts in the body of a NELSON Gate Valve

TRADE-MARK REGISTERED

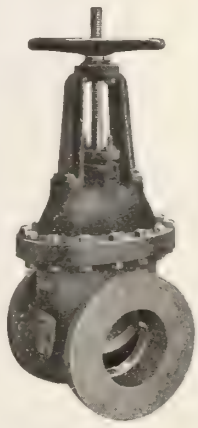
two tapered discs and *one* central wedge

Standard Bronze Gate Valve

All simple. Nothing complicated. Cannot get out of order. Require only very small space; the body is therefore compact and *very strong*. They act as harmoniously as if they were cast solid.

Only three parts: two tapered discs, one central wedge

These three parts provide a mechanism that will fit the seats, not only when new, but even should the seats become distorted from their original angle, because of contraction or expansion or through abuse.



Medium Iron Body Gate Valve

Try just one in the hardest place you have. **NELSON** *Valves can also be had in GLOBES, ANGLES, or CHECKS, made of Bronze, Iron or Steel.*

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BY USING THE

"ECONOMIC" VACUUM VALVE

¶ By a single operation you can attach the vacuum valve to the old gravity type of heating apparatus, and keep the radiators always hot, with an economy in coal consumption as well.

¶ There is wide scope for its application in factories, etc., to work up high temperatures in dry kilns, dryers, blast heater, coil stacks, etc.

¶ The construction of the valve is simple, and it is easily cleaned. There are two chambers, in the first of which the dirt is screened from the condensation, and is easily removed.

¶ This valve is of the latest pattern in every respect. It is impossible to overload or flood in it any way.

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Limited

186 Queen Steet East, Toronto.

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CORRUGATED TUBE

POWER HOUSE SUPPLIES

Fairbanks Globe, Gate and Check Valves.
Fairbanks Asbestos Packed Cocks.
Pipe and Pipe Fittings.
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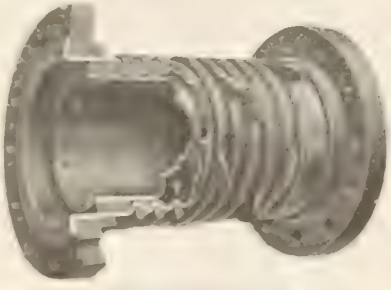

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IMPROVED EXPANSION JOINT

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WAINWRIGHT
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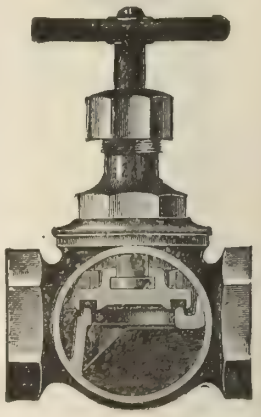
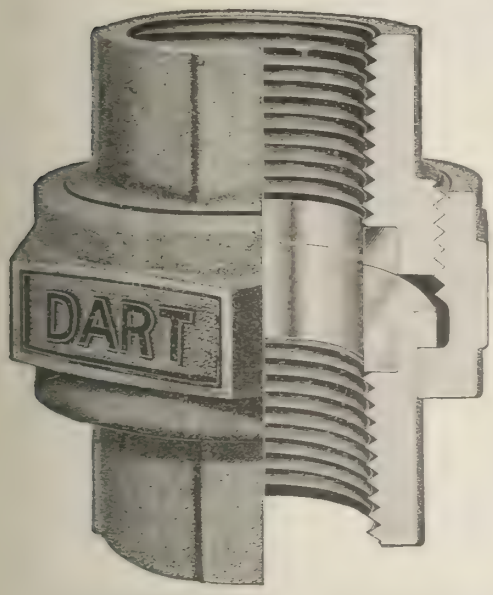


FAIRBANKS
RENEWABLE DISC
VALVES

BRONZE TO BRONZE



"Dart" Unions
CANNOT LEAK

The Bronze to Bronze joint of the DART UNION is guaranteed never to rust or corrode.

The Ball Shaped Seat allows a quickly and easily made connection whether pipes are in or out of line—a connection that STAYS TIGHT until deliberately loosened.

You can connect or disconnect the Dart Union as often as you like without decreasing its efficiency.

Before placing your order for unions investigate the record of the DART. Write us for the names of users in your town and ask them what they have to say regarding the efficiency of this time and money saver, or write for samples and put them to the test yourself.

We guarantee Dart Unions to do all we claim for them and will replace with two unions any one found defective.

Dart Unions are sold by nearly all dealers and are made in screwed, flanged, tee and elbow types, male and female.

DART UNION CO., Limited

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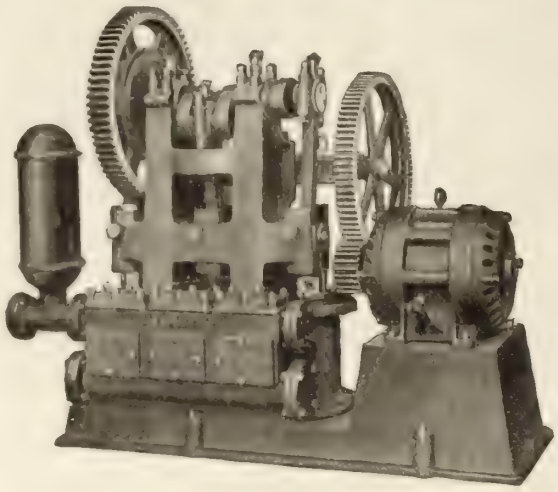
DEMING TRIPLEX PUMPS

Deliver An
EVEN, STEADY STREAM



GENERAL SERVICE DEMING TRIPLEX POWER PUMP FOR OPERATION BY ELECTRIC MOTOR
Made in all sizes

One plunger is always on the downstroke.

This maintains an unwavering pressure.

Liquids flow from the discharge pipe in a steady stream, free from pulsations.

No jerky action to wear out the motor.

Made also for operation by belt and gas or gasoline engine.

Tell us under what conditions your pumps will have to work.

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Salem, Ohio : : U.S.A.

Hand and Power Pumps for all Uses

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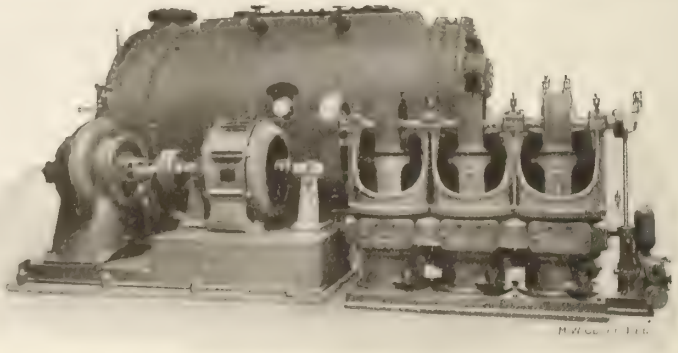
Highest Vacuum

Special



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Designs

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OF EVERY DESCRIPTION

BAROMETRIC LOW LEVEL JET or SURFACE

All on the Counter-Current Principle

"EDWARDS" VALVELESS AIR PUMPS DRY AIR PUMPS

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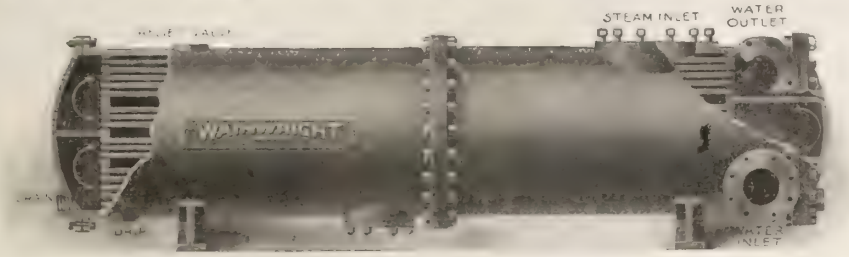
Vancouver Office: 427 Seymour Street. H. W. KENT, Local Manager.

Wainwright Water Heater



A Heat Unit Saved from the Exhaust is Worth Two in the Coal Pile

In industrial plants, such as bleacheries, dyehouses, paper mills, laundries, where the hot water load is large, great saving may be effected by the proper economical utilization of heat from the exhaust of the main engine.

WAINWRIGHT WATER HEATERS are designed especially to fulfill the requirements of such installations

In the non-condensing plant, these heaters may take steam from the main exhaust. In the condensing plant they may best be operated in connection with a vacuum apparatus.

We are prepared to give expert advice on this subject.

Catalogue No. 14 describes this apparatus in detail.

ALBERGER CONDENSER COMPANY

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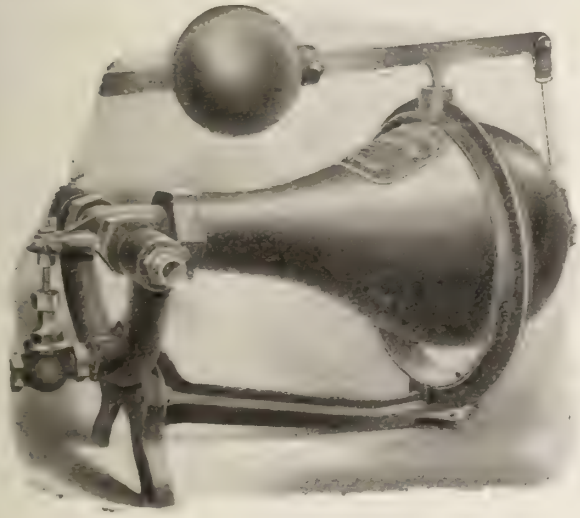
Canadian Fairbanks Company, Limited, Agents MONTREAL TORONTO WINNIPEG VANCOUVER



Why does the mere mention of the words

"Steam Trap"

at once suggest

"BUNDY?"

BECAUSE Bundy Steam Traps mean Bundy Service.

BECAUSE Bundy Service means Results to Bundy Owners.

BECAUSE A Bundy Owner is a Satisfied Owner.

BECAUSE This satisfaction is due to Bundy Service.

We are specialists in Condensation, and undertake all problems looking to greater efficiency and economy in Steam Plants of every description.

Catalogues and our pamphlet, "The Saving of Heat Units," are gladly mailed on request.

We are also ready to furnish expert service in connection with all questions relating to Heaters, Condensers (Steam and Ammonia), Shaking Grates, Special Engine and Ammonia Packings, and every form of pressure and temperature control.

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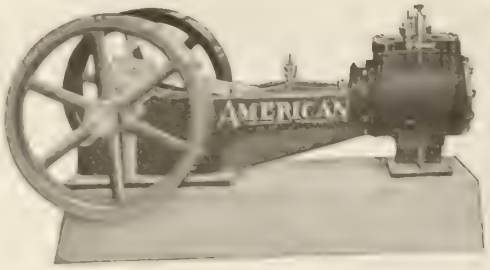

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STEAM AND POWER DRIVEN

AIR COMPRESSORS

FOR air lift systems, pneumatic tool service, machinery cleaning, and in fact every service where compressed air is used. these compressors have established an enviable reputation for EFFICIENCY, RELIABILITY and LOW COST OF MAINTENANCE.

They are designed according to the latest engineering practice and can be depended upon to work to full capacity under all conditions.

The Marsh Steam-Driven Air Compressors are equipped with the famous Marsh Self-regulating Steam Valve which proportions the amount of steam consumed to the work done by the air end, and is especially adapted to air compressor service.

LET US FIGURE ON YOUR COMPRESSED AIR PROBLEMS

Write to-day for booklet describing our line of compressors and their uses.

American Steam Pump Co.

Battle Creek, Mich.

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QUALITY

Counts in

Gauge Glasses

Bishops ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES

have been tested under all conditions and have proved their superiority over all others.

Write us for Further Particulars

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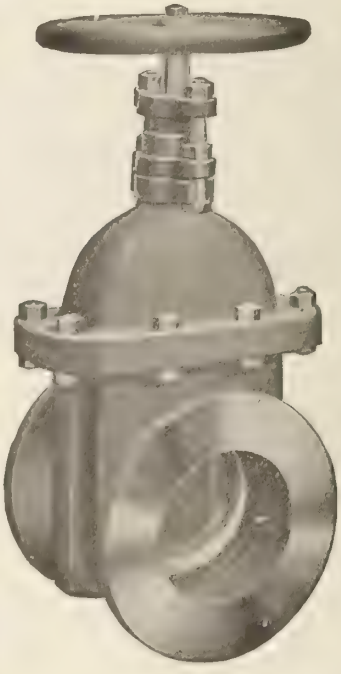


Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The

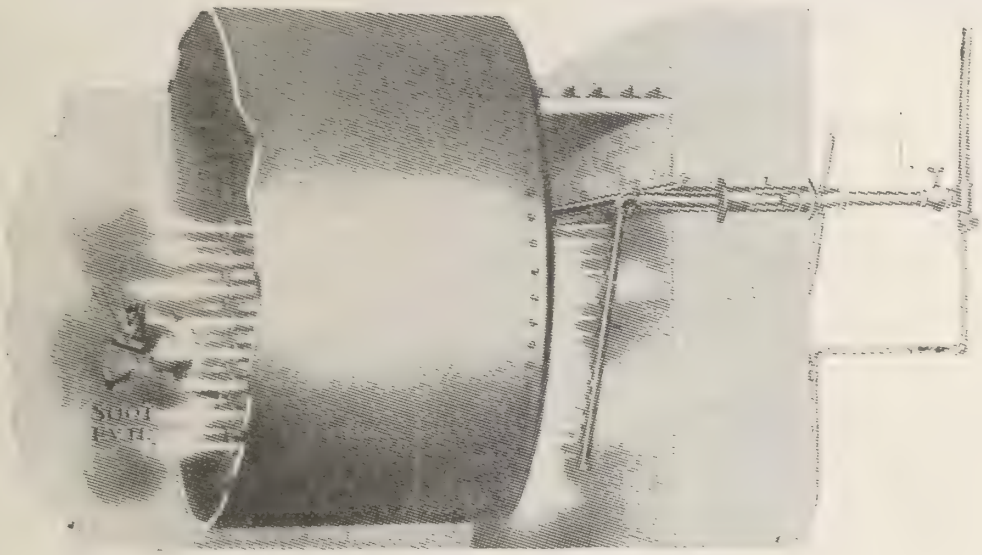
Kerr Engine Co., Limited

Valve Manufacturers

WALKERVILLE - ONTARIO

A CLEAN BOILER MAKES A NOISE LIKE A DIVIDEND

SAVES FUEL SAVES LABOR INCREASES BOILER CAPACITY



A Vulcan Installed on a Fire Tube Boiler

THE VULCAN SOOT CLEANER is a stationary system of piping (applicable to all types of water-tube boilers) operated by valves at the side of the boiler. Long perforated pipes are located so as to send jets of steam between every row of tubes blowing with the draft. In parts of the first pass of tubes, special heavy nozzles are used, which are most effective.

SOOT on a water-tube boiler DEFIES removal by hand blowing.

THE VULCAN SYSTEM sweeps the heating surface from end to end, the soot being driven from the front end of the boiler to the rear end into the combustion chamber where it belongs, and thence, if desired, up the stack. With hand blowing, the little soot that is reached is not removed, simply transferred,—blown from the near to the far side of the boiler. Inspect any hand blown boiler at the end of a month's run, and note for yourself the great quantity of soot that is present,—there may be a wagon-load there.

You can FORCE some heat through SOOT, but consider the loss? Why attempt to heat through soot unnecessarily?

THE VULCAN SOOT CLEANER IS THE ONLY SOLUTION TO THE SOOT PROBLEM.

THE VULCAN SOOT CLEANER PERMITS OF FREQUENT AND ABSOLUTELY THOROUGH CLEANING.

You will be interested in our booklet, "Economical Steam Production." We will send you a complimentary copy on request.

Give us the following information—type of boiler—pressure—number of tubes high—we will send you without charge a proposal for you consideration. Write to-day.

ALL INSTALLATIONS ARE GUARANTEED, AND YOU HAVE 30 DAYS' TRIAL.

Vulcan Tube Cleaning Systems, Limited

General Offices:
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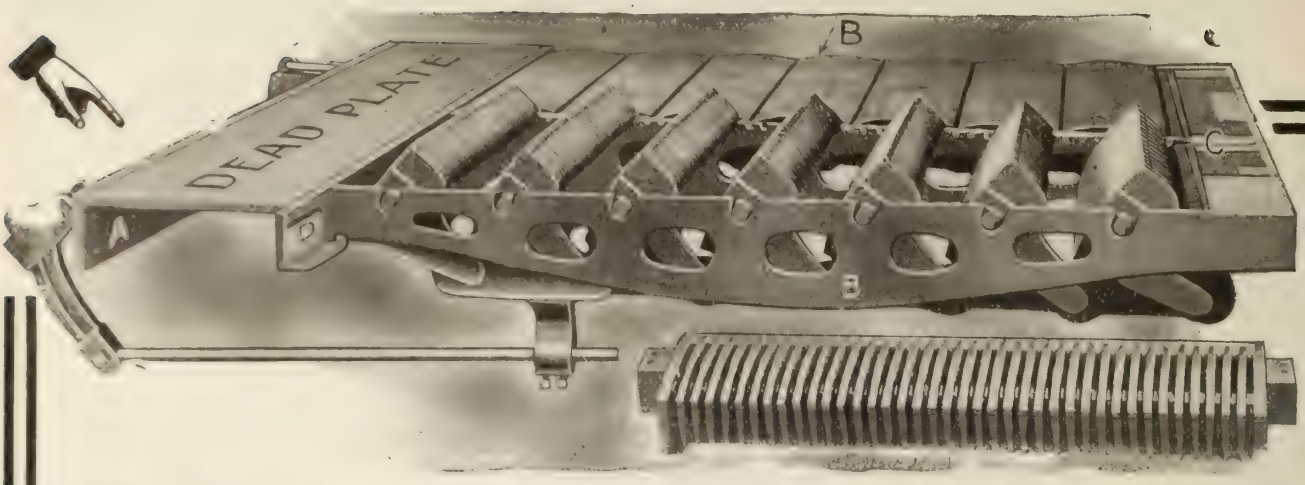
J. L. NEILSON & CO., 602 Main St, WINNIPEG



The Cyclone Shaking and Dumping Grate Bar

is constructed so as to allow 68% air space and 9% under draught, thus giving the maximum results from cheap fuel, such as soft or hard coal screenings, hard or run-of-mine coal, breeze, etc. Fuel cannot be wasted when grates are shaken, as the openings between the bars are no greater "when shaken" than when left level It is impossible for "CYCLONE" bars to get out of plumb by heat as they are constructed to overcome this defect Find out what users have to say regarding this fuel economiser—write us for testimonials.

WRITE US AT ONCE

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

186 QUEEN STREET EAST - - - - TORONTO, CANADA

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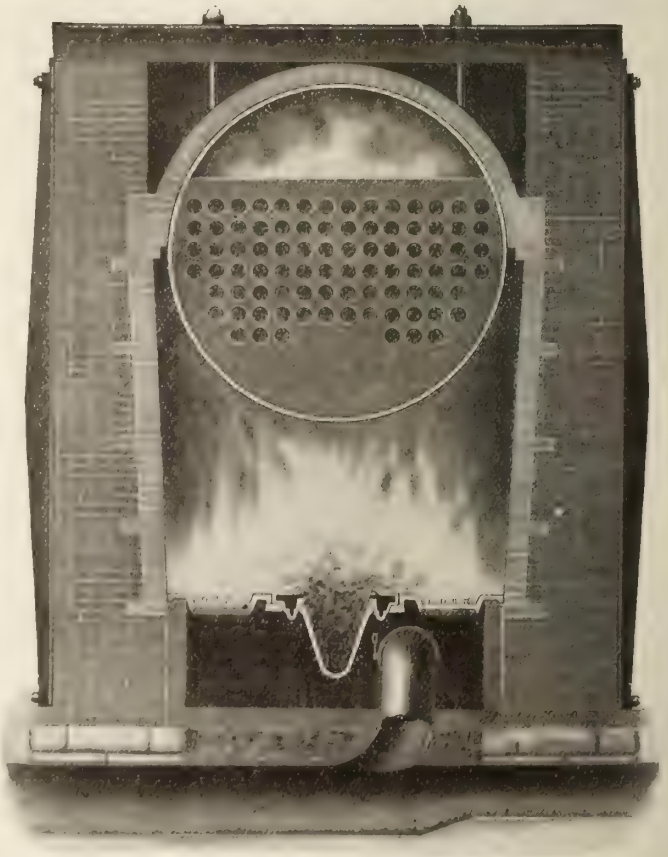
THE JONES UNDERFEED SYSTEM OF FIRING produces the highest obtainable degree of economy in the burning of Bituminous Coal.

"The proportioning of the fuel supply and the air supply is a requirement absolutely necessary to produce perfect combustion!"

The Jones Underfeed Stoker System applies this identical principle in mechanical stoking, but going a step in advance, **THE STEAM PRESSURE ITSELF** automatically proportions the fuel and the air to each other, and to varying boiler loads, therein exercising **AUTOMATIC CONTROL IN ITS TRUEST AND MOST ABSOLUTE SENSE.**



The Jones Underfeed Stoker Co., Limited

National Trust Building TORONTO

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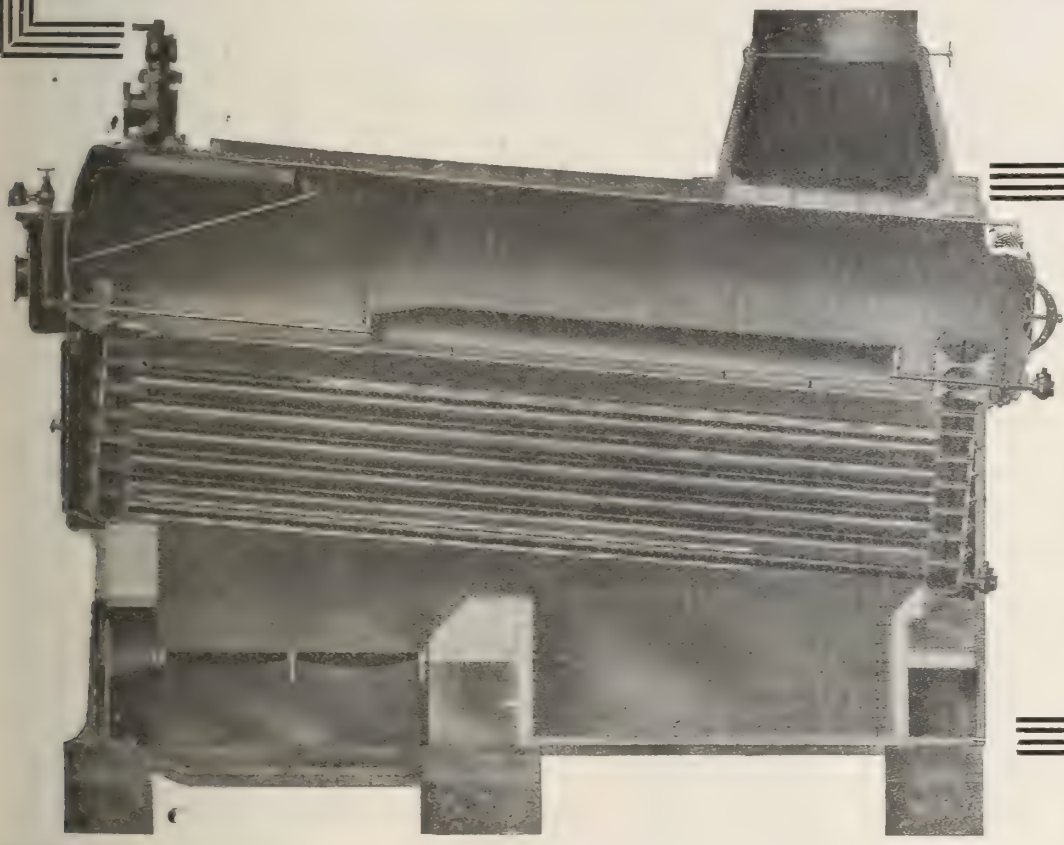
Efficiency -- Reliability

THE HEINE SAFETY BOILER has proved its efficiency and reliability in many of the world's best steam plants.

This is a broad claim, but we can prove it by the many letters we are constantly receiving from satisfied users. These letters are yours on request.

Great care in testing of materials guarantees a perfectly safe boiler at high pressure, the boiler as a whole being submitted to a rigorous inspection and test before leaving our shop.



Heine Safety Boiler

THE HEINE SAFETY BOILER is not only constructed so that it will best absorb and transmit the heat, but also that the heat may easily reach it.

The constant action of HEINE Mud Drum precipitates and discharges all mud and scale.

Write for descriptive matter regarding the action of this superior boiler

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TORONTO **ONTARIO**

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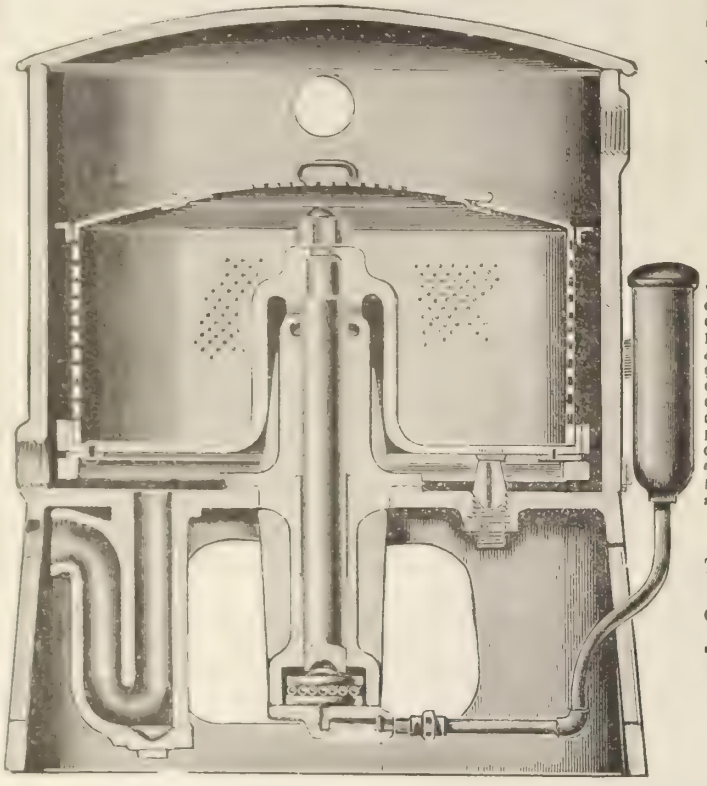
IMPROVED WASTE MACHINE
WITH
WASHING ATTACHMENT



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Save Oil—Save Waste

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OIL and WASTE MACHINES, CHIP MACHINES, TURBINE CENTRIFUGAL OIL FILTERS, and CENTRIFUGAL EMULSION MACHINES

We have machines with—The E. B. Eddy Co., Ltd.; Grand Trunk Railway; Can. Pac. Ry.; Dominion Coal Co.; J. R. Booth; Toronto Water Works; T. Eaton Co.; Montreal Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oat Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co.; Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.; Consolidated Mining & Smelting Co.; Montreal Cotton Co.; Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd.; J. & P. Coates, Ltd., and many others.

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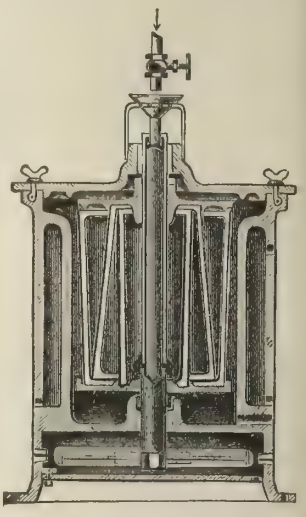

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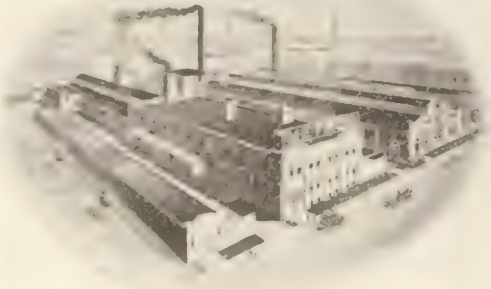

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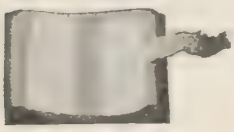
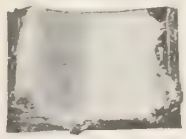


Ran 15 minutes, 1,000 lbs. square inch

Ran 30 minutes, 500 lbs. square inch



Ran 15 minutes, 1,000 lbs. square inch

Ran 5 minutes, 1,000 lbs. square inch

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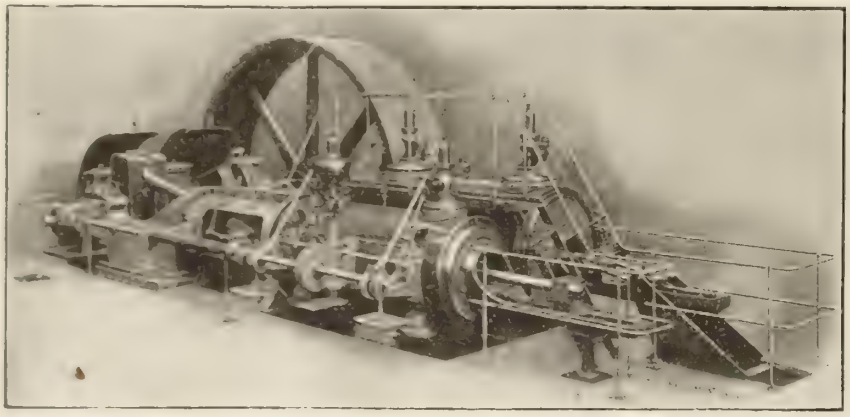

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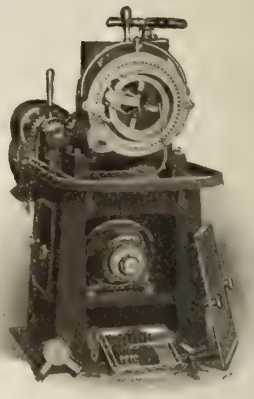

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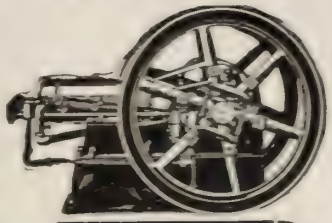

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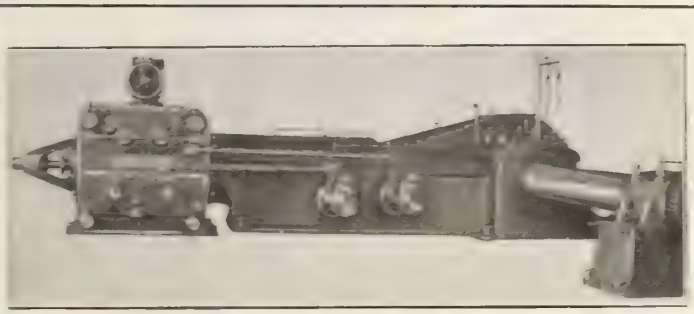

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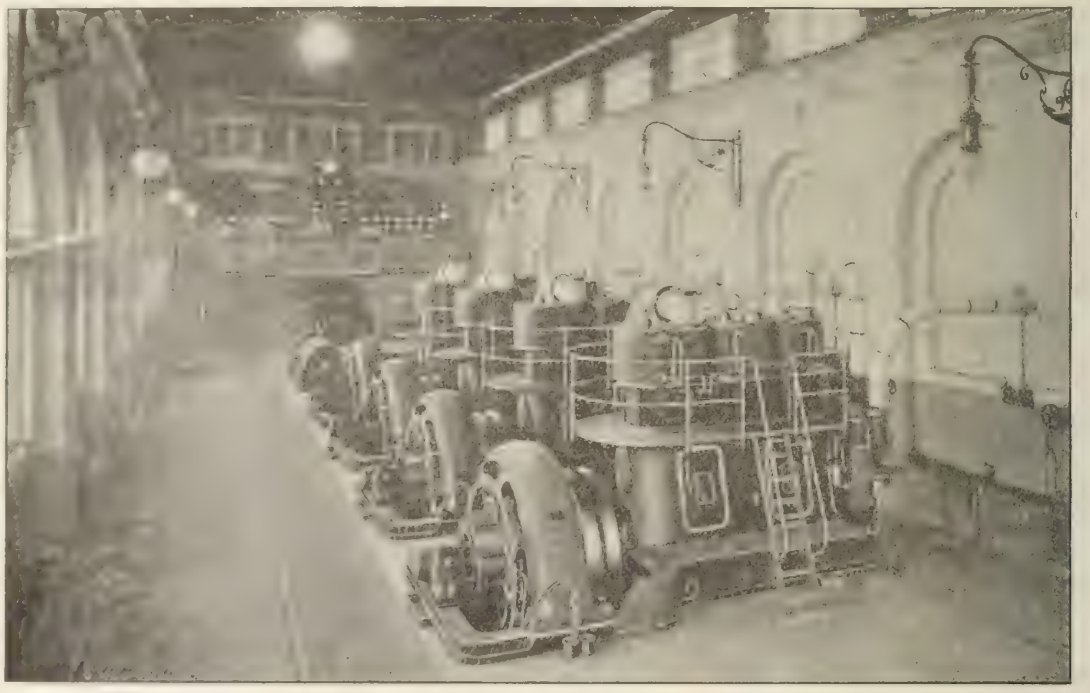

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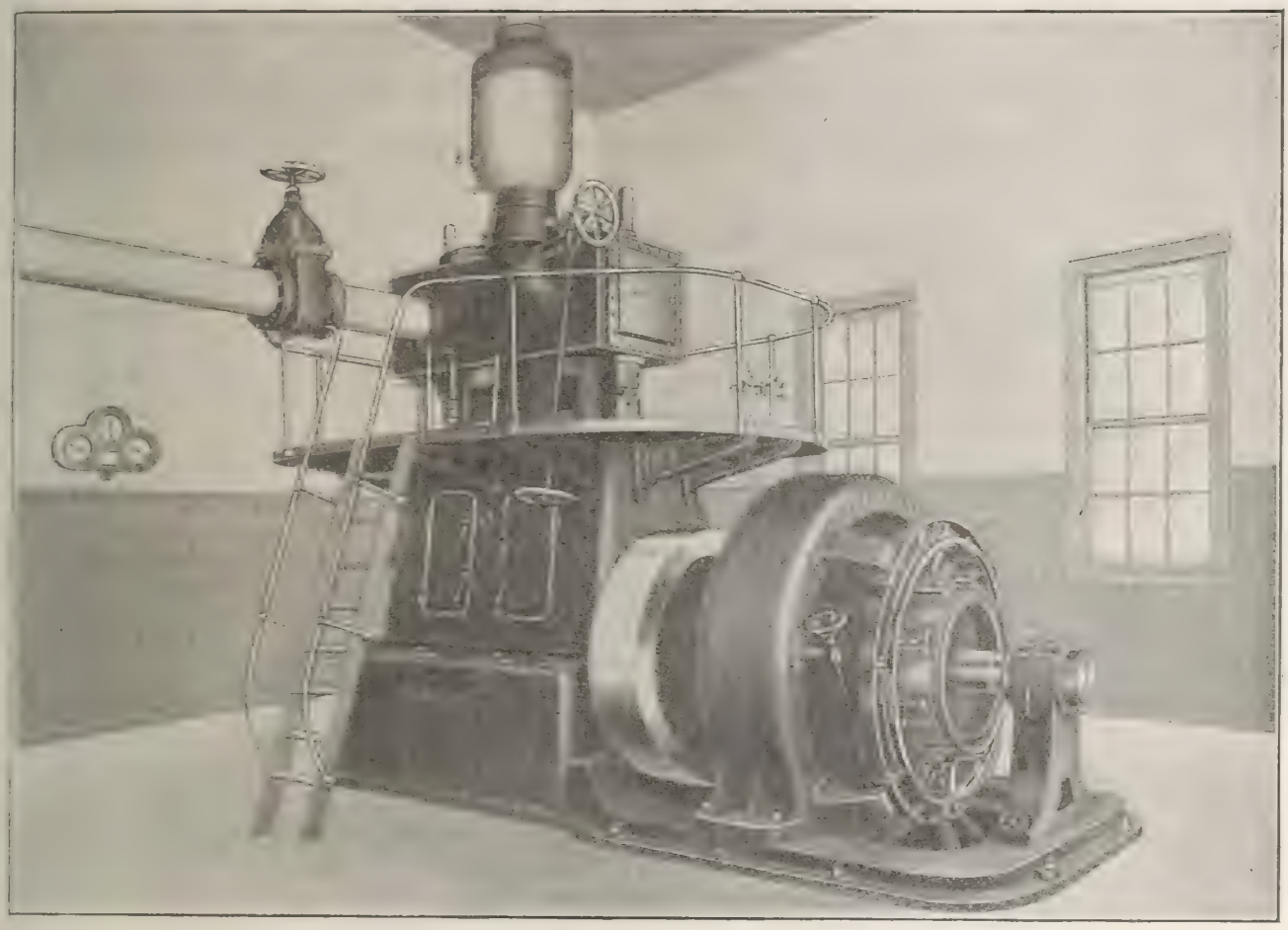

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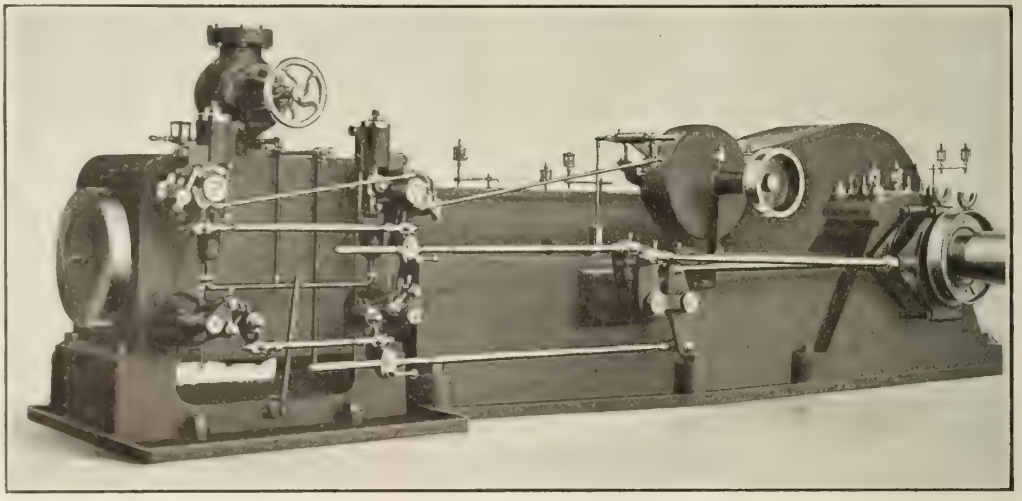

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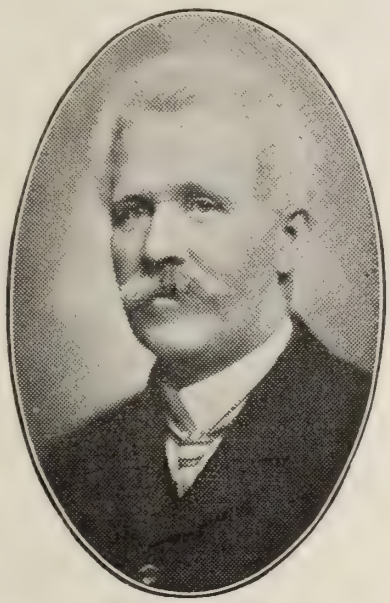
22nd Annual Convention of the C.A.S.E. at Stratford, Ont.

Progress and Enthusiasm for the Association's Work in Future Were Marked Evidences of the Three-day Convention Held in Stratford Last Month. The Benefits Derivable From Men Banding Themselves Together, for Mutual Help and the Uplift of Their Profession, is a Hopeful and Encouraging Sign, and When Persisted in With Increased Vigor, a Condition Particularly Applicable to the C. A. S. E., no Word of Praise Bestowable by us is Withheld or Withdrawn. A Growing Realization of the Importance of the Stationary Engineer to His Employer and to the Community in Which His Duties Place Him, is Becoming Yearly More Pronounced, and no More Convincing Sign of This is Needed Beyond the Co-operation of Power Plant Specialty Manufacturers, Who, Through the Affiliated Exhibitors' Association, are Increasing the Scope and Value of the Convention Exhibition Each Succeeding Year.

THE Twenty-Second Annual Convention of the Canadian Association of Stationary Engineers was duly opened at the City Hall, Stratford, on Tuesday morning, 25th July, by His Worship, Mayor Brown, who, after introduction by A. Kastella, was loudly applauded, on rising to speak. He expressed great pleasure to have the C.A.S.E. hold its convention in their classic city, and to see such a goodly representation of delegates together with a fine exhibit, which, although he did not profess to know much about, showed the advances being made by the different trades concerned. He extended to one and all a warm welcome to Stratford, and gave assurance that they would receive the best attention from the local lodge, No. 31. He further expressed the hope that at some future date, they would again make Stratford the place of their convention, and that meantime, they would carry away pleasant memories of their brief sojourn.



JOHN BROWN.
Mayor of Stratford.

Mr. Crockett, acting chairman, then called on Mr. Heeg, executive president, Mr. Wickens, treasurer, and Mr. Robertson, conductor of the C.A.S.E., to address the meeting.

Mr. Heeg stated that it was a pleasure for him, as executive president, to be a delegate to this convention, and he felt sure that everyone would have the best and most profitable time thay had yet experienced.

Mr. Wickens thanked the mayor for the cordial reception tendered them, and was sure their visit would be such that every one would go away perfectly satisfied and feeling the better for it.

Mr. Robertson, financial secretary of the Stratford Lodge No. 31, joined with the mayor in extending a most cordial welcome to the delegates.

With the close of the addresses a hearty vote of thanks was tendered

STRATFORD CITY HALL. WHERE THE CONVENTION WAS HELD.

Mayor Brown for the welcome extended them. This was followed by three rousing cheers and a tiger. The delegates afterwards adjourned to the council chamber, to discuss association business.

R. PATTERSON

Master Mechanic G.T. Shops, Stratford, Hon. President No. 31.

Delegates in Convention.

Tuesday a.m.—On arrival at the council chamber, the business of the convention was started, by appointing the following committees :

Credentials.—Bros. W. A. Crockett, Mount Hamilton ; W. Lamberton, Hamilton ; F. H. Chesher, Belleville.

Auditing.—Bros. H. E. Terry, Toronto ; Alex. Scrimgeour, Stratford ; Geo. Moll, London.

Striking and Standing.—Bros. C. Emmerich, Berlin; Chas. Moseley, Toronto; H. J. Wickens, Brampton ; H. Creagon, Ottawa ; W. Herman, Chatham ; S. E. Cosford, London.

Adjournment was then made until 2.00 p.m.

* * * * * * * * * * * *

Tuesday p.m.—The report of the credential committee was received and adopted, after which the president addressed the delegates as follows :

PRESIDENT'S ADDRESS.

Stratford, Ont., July 25, 1911.

To the officers and delegates assembled here in convention.

Dear sirs and brothers :—

It certainly is an honor for me to be here, as your executive president. I regret that in spite of a large amount of correspondence with the different executive members, there has not been too much accomplished, but with the experience I have had in office during the year, I feel that better results are attainable, and in order to secure them, I beg to offer the following suggestions.

Suggestions Towards Results,

First.—Ways and means should be arranged to have the executive meet at least four times a year, to confer on matters for the good of the order, and a report of the business transacted should be sent to each and every subordinate association, with a view to have them discuss and send in resolutions pertaining thereto. This will bring about two things ; first, a closer co-operation of the executive members ; second, a closer co-operation between executive and subordinate associations, of which there has not been enough. If this were arranged, it would, I am sure, be generally appreciated.

A. KASTELLA, STRATFORD

President No. 31, Secretary of Convention Committee.

VICTORIA PARK, STRATFORD.

Second.—I also believe, that the past presidents might also be induced to lend a helping hand to further the interests of the association. They have experience, and are capable of additional good work to that already done by them. I

W. G. WALTERS, STRATFORD

Recording Secretary No. 31 and Chairman Entertainment Committee.

am satisfied, this would be an excellent thing for our association.

Third.—There should be some system outlined whereby every man belonging to the C.A.S.E. would be considered something above ordinary as an engineer, and I would suggest as follows: (Clause 5). That a set of questions be prepared, for every subordinate lodge to use for the education of the engineers belonging to it, in good standing. The questions to be both technical and clerical. In the technical section, information should be provided on the fundamental principles of the different apparatus used in our profession; in the mechanical, some practical information and explanations in operation should be given; while in the clerical, which is getting to be a very important factor in all plant operation, a good system of keeping daily records of the plant operation is desirable.

In making this last suggestion, I have found from practical experience, that the system is poor in the majority of steam plants, because the engineer has not had business capacity training enough, to carry it out effectively. These suggestions, as well as a good many others would, if adopted, and taken up in the manner stated, by past presidents and executive officers, certainly get this association something that no other organization has ever attempted, because they are not working for the common good as we are. This can all be brought about by energetic work at little expense. The foregoing, I beg to submit respectfully for your consideration.

Yours fraternally,

JOHN J. HEEG,

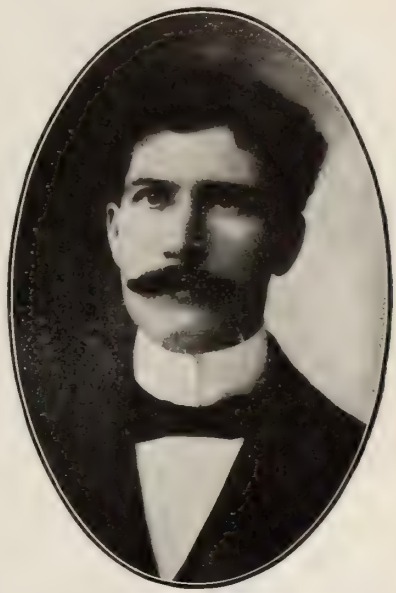
Executive President, 1910-1911.

Secretary's Report.

Stratford, July 25th, 1911.

To the Officers and Brethren of the Executive of the C.A.S.E.:—

It is again a pleasure for me to report that our order is in a very good state, and that there is evidence of still



J. A. ROBERTSON, STRATFORD.

Executive Vice-President, C.A.S.E.

greater things in store for us. We have added two new lodges to our ranks: St. John, N.B., with a membership of about sixty, and Port Arthur with a membership of about thirty.

A VIEW ON CHURCH STREET, STRATFORD.

preference being given for the existing arrangement.

A petition was sent to the Provincial Legislature in re graded certificates, and a reply was received from the Hon. Sir James Whitney to the effect that action would be taken.

W. NORRIS, CHATHAM
Executive President, C.A.S.E.

Several complaints were received from the subordinate lodges, in re 50 per cent. per capita tax reduction, and an opinion expressed that it be made 75 per cent. to assist them at the present time. All of which is respectfully submitted.

W. A. Crockett.

A plebescite submitted, to see whether a biennial convention would be more satisfactory to the members than an annual one, showed a vote of 400 to 1 in favor of the latter.

A. M. WICKENS, TORONTO.
Executive Treasurer, C.A.S.E.

It was decided to allow the per capita tax to remain as it is for another year.

The various committees brought in their reports, after which the meeting adjourned at 3.35 p.m.

Visit to the G. T. R. Shops.

Following the close of the delegates' session on Tuesday afternoon, a visit was paid the G.T.R. shops, in which under the guidance of master mechanic Patterson an enjoyable and instructive hour was spent observing the various items of work in progress and the modern equipment for handling it. Much favorable comment was expressed regarding the high degree of system, order and tidiness which was everywhere apparent.

Banquet in G. T. R. Assembly Hall.

The banquet provided by the local lodge, and held on Tuesday night in the Grand Trunk assembly hall, was a most enjoyable function. It reflected in its success great credit on caterer Brown and his corps of assistants, as well as on the members of the local committee. There were about two hundred present, including many ladies and a good sprinkling of citizens, several aldermen being among the number.

The hall was tastefully decorated with flags and bunting, and Sturms' orchestra furnished delightful music while the banquet was in progress.

Mr. R. Patterson, master mechanic G.T.R., occupied the chair, and had on his right, at the head table, Mayor Brown, ex-Mayor Dingman, J. R. Macdonald, president of the Board of Trade, A. Scrimgeour and A. Kastella ; and on his left, Messrs. J. Heeg, president C. A.S.E., Geo. McLagan, John Goff, of the Exhibitors' Association, A. Wickens and W. A. Crockett, past presidents C.A.S.E., and W. G. Walters. After the banquet, a long toast list interspersed with songs, humorous and sentimental, brought a long-to-be-remembered function to a close, with the hearty singing of "God save the King."

WEDNESDAY, JULY 27TH.

A business session of the executive committee, occupied, with inspection of the exhibits by the delegates, the morning of this the second day of the convention. In the afternoon at 2 o'clock, a group picture of ladies, delegates, exhibitors and guests was taken on the steps of the city hall, after which the G.T.R. band led the way to Victoria Park, followed by a full representation of convention folks on foot, in busses, autos, and other conveyances. The programme of sports provided here, and the ample arrangements made, in the nature of refreshments for all, reflected the greatest credit on the entertainment committee of the exhibitors' association.

Picnic Features.

Of the many interesting events of an eventful afternoon, those of the baseball game between engineers and exhibitors and which was won by the latter ; the wheelbarrow race, won by Paynter and

J. J. HEEG, GUELPH
Executive Past President, C.A.S.E.

Galloway ; the fat man's race won by W. C. McGhie, the boxing tournament won by A. Kastella ; the pie-eating contest won by H. Smithers, and the splitting of his pants across one knee by George Moll in the wheelbarrow race, were undoubtedly prominent.

During the progress of the sports and picnic, a large number of delegates and guests took advantage of the opportunity afforded to visit the water-works system and normal school, both of which were close by the park.

Return was made to the city in like manner to that by which the outgoing journey had been made, with the addi-

W. A. CROCKETT, MT. HAMILTON.
Executive Secretary, C.A.S.E.

THE 22ND ANNUAL CONVENTION OF THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS, HELD AT STRATFORD, ONTARIO, JULY 25-26-27.

Group Picture of Delegates, Exhibitors and Guests on the City Hall steps.

tional feature of Messrs. Moll and Kastella doing fantastic pugilistic stunts in advance of the band.

Fire Brigade Run-out.

There took place a run-out of the city fire brigade for exhibition purposes, an alarm having been rung in with that end in view. We cannot but compliment the city of Stratford on its smart and highly efficient fire-fighting equipment, and the hearty cheers which greeted the brigade on its return, and the enthusiasm and favorable comment displayed and heard, went to show that the large cities are not more thoroughly provided in respect of men, horses and machines.

Exhibitors' Association Entertainment.

This consisted of a smoker and reading of papers on "The Cost of Steam Power in Ontario," by J. O. B. Latour, of the Canadian Casualty and Boiler Insurance Co., Toronto, on "Problems in Heating," by D. K. Dean, of the Alberger Condenser Co., New York, on "The Operative Engineers' Ideal and its Attainment," by Peter Bain, editor of The Power House, Toronto, and a number of humorous and tragic deliverances by Jack Armour, of Power, New York. A further social hour at the Windsor Hotel succeeded the smoker adjournment.

THURSDAY, JULY 28TH.

The C.A.S.E. executive held a morning session, and decided on Belleville as the next convention city, the date as usual being the last week of July, 1912. On account of the secretary, Mrs. Spratt's illness, no report was furnished of the progress of the Women's Auxiliary. A general discussion on the benefits derived from the C.A.S.E. was heartily indulged by a majority of those present.

Exhibitors' Association Officers, 1911-1912.

The Exhibitors' Association held their annual meeting this a.m., and after hearing the secretary's and treasurer's reports, both of which were highly satisfactory, proceeded to the election of officers for the ensuing year.

H. R. CLARK, HAMILTON.
Executive Conductor, C.A.S.E.

President, Earl F. Hetherington, Goldie & McCullouch Co., Galt; 1st vice-president, J. E. Fiddes, the Jas. Morrison Brass Mfg. Co., Toronto; 2nd vice-president, John B. Goff, The Dart Union Co., Toronto; secretary, Gordon C. Keith, editor "The Canadian Manufacturer," Toronto; assistant secretary, J. N. Charles, The Canadian Fairbanks, Co., Ltd., Toronto; treasurer, H. V. Tyrrell, business manager, "The Power House," Toronto; superintendent of exhibits, W. R. Stavert, Jenkins Bros, Montreal; chairman of entertainment Committee, Peter Bain, editor "The Power House," Toronto.

Presentation and Vote of Thanks.

A five-dollar gold piece was donated to Miss Keith, daughter of Gordon Keith, of "The Canadian Manufacturer," to mark the advent of the little lady during convention week, after which a vote of thanks was tendered the retiring officers for their work during the previous year.

C.A.S.E. Executive, 1911-1912.

President, W. Norris, Chatham; vice-president, J. A. Robertson, Stratford; secretary, W. A. Crockett, Mount Hamilton (re-elected); treasurer, A. M. Wickens, Toronto, (re-elected); Conductor, H. R. Clark, Hamilton, door-keeper, S. E. Cosford, London. These officers were duly installed at the close of the election, and retiring president, J. J. Hee of Guelph, was presented with a pas president's jewel.

Presentation to Local Brethren.

A silk umbrella was presented to Bro Walters by Jack Armour, on behalf o the Exhibitors' Association, as an ap preciation of the assistance rendere them by him, during the convention.

An umbrella was also presented t Bro. Kastella, by Bro. Moseley of To ronto, to show their appreciation of th support given by him in the transactio of the convention business.

Appropriate replies were made b Bros. Kastella and Walters, after whic the convention adjourned.

* * *

THE LADY GUESTS.

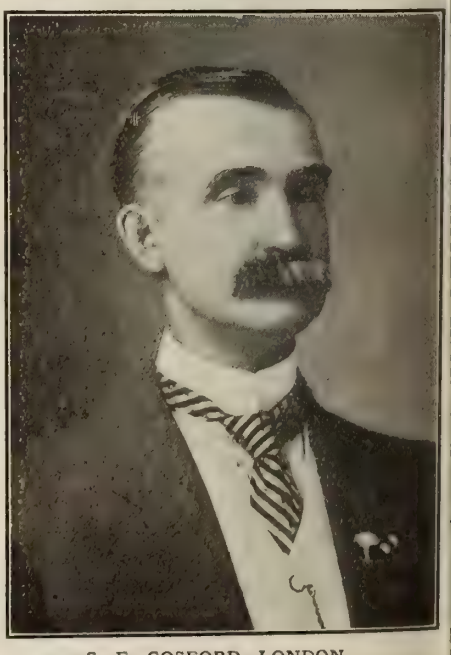
As had been promised, the special efforts to cater for and provide the greatest possible enjoyment and comfort fo the lady visitors and guests, were more than fulfilled. In addition to participating in the group picture, the visit to the G. T. R. shops, the banquet, the sports and picnic, along with their masters (?) there was an endless round of gaiety, in the whirl of which such interesting features as the visit to Mooney's biscuit factory, automobile rides, ice cream socials, etc., formed part.

* * *

DETAIL OF EXHIBITS.

The Goldie & McCulloch Co., Ltd., Galt, Ont.—Catalogues of Wheelock engines, feed water heaters, condensers and pumps, Ideal high-speed engines, Goldie Corliss engines, Wheelock instruction book, and boiler catalogue. Representative, Mr. Hetherington.

W. C. McPHIE, TORONTO
Chairman Examining Board



S. E. COSFORD, LONDON.
Executive Doorkeeper C.A.S.E.

The Boiler Repair & Grate Bar Co., Toronto—Sample 20th Century shaking and dumping grate bar. Representatives, Messrs. Hett and Smythies.

EARL F. HETHERINGTON, GALT
President Exhibitors' Association.

Twin City Oil Co.—Oils, Manzel Bros.' sight feed oil pump, boiler compound, etc. Rrepresentative, Mr. Phillips.

The Garlock Packing Co., Hamilton—Full line of rod and sheet packing. Representative, Mr. Pulver.

The Canadian Manufacturer, Toronto—The Canadian Manufacturer and Railroad Journal publications. Representatives, D. O. Mackinnon, J. C. Armer and G. C. Keith.

The Power Economies, Ltd.—Eclipse boiler enamel, Claflin tube cleaners, the Pittsburg steam and oil separator, the Crescent grate bar, the Pittsburg vacuum exhaust head and recording gauge, the General Specialty Co., Buffalo, tube cleaner. Representative, J. A. Cartwright.

The Morehead Mfg. Co., Detroit.—Morehead traps and equipment, and the Otis water purifier. Representatives, Geo. W. Cole and W. T. Clark.

The Can. Fairbanks Co., Toronto—A full line of power plant specialties, consisting of valves, gauges, packing, oil filters, etc. Representatives, Geo. E. Fisher and J. N. Charles.

The Strong, Carlisle & Hammond Co., Boston—The Strong engine stop, electrically operated and general power plant equipment. Representative, F. H. Evans.

The Eadie, Douglas Co., Toronto—The Richardson automatic sight feed oil pump, pressure gauges, Nelson valves and floor stands, direct separators, Scaife steel filters, injectors, blow-off valves, etc., and catalogues.

The Lunkenheimer Co.—Brass rail stand, with gate valves (wheel and lever), check valves, safety valves, lubricators, whistles, etc. Representative, Ernest A. Wilkinson.

The Engineering Journal, Toronto—Copies of the "Engineering Journal."

H. L. Peiler & Co., Montreal—Bundy traps, Skinner re-seating machine, McCrae joint clamps, Federal metallic packing, pump valves, pressure and vacuum gauges, etc. Representative, John G. Abraham.

The James Morrison Brass Co., Toronto—Engine room gauge board, with clock, pressure, receiver, vacuum and recording gauges, plated and mounted; also lubricators, inspirators, water columns, gauge testers, tree stand with pipe fittings, whistles, Anderson steam trap model, etc. Representative, James E. Fiddes.

The Dart Union Co., Toronto—Assortment of unions, couplings, flanges, elbows, bushed and otherwise. Representatives, J. B. Goff and Mr. Archibald.

The Dearborn Drug & Chemical Co., Buffalo—Circulars and catalogues descriptive of boiler compounds. Representative, Joseph N. Gregory.

The Cling-Surface Co., Buffalo—Circulars and catalogues descriptive of the applications and economies resulting from the use of Cling-surface compounds in power transmission. Representative, J. B. Faatz.

"Power," New York—Copies of the current and recent issues of that publication, together with engine room hangers, having pointed and appropriate counsel inscribed. Representative, Jack Armour.

J. E. FIDDES, TORONTO
Vice-president, Exhibitors' Association.

The Peerless Rubber Co.—Representative, Mr. Heintzman.

The Quaker City Rubber Co.—A full line of rod and sheet packing. Representative, Mr. Myers.

"The Power House," Toronto—Copies of current and recent issues of that publication. Representatives, H. V. Tyrrell, business manager, and Peter Bain, editor.

* * *

CONVENTION SOUVENIRS.

The cut shows in compact form the more important souvenirs distributed by exhibitors, and are credited as follows:

GORDON C. KEITH,
Secretary, Exhibitors' Association.

1. Silver-mounted amber cigar holder —The Peerless Rubber Co.

2. Souvenir button—The Jas. Morrison Brass Co.

3. A dart or stick pin—The Dart Union Co.

4. Outside calipers—The Garlock Packing Co.

5. Plated badge—"Power," New York.

6 and 8. Plated pencil holder—The Goldie & McCulloch Co.

7. Celluloid scale—The Dearborn Drug & Chemical Co.

9. Plated and celluloid pencil holder —The Quaker City Rubber Co.

10. Delegates' and exhibitors' badges —"The Power House."

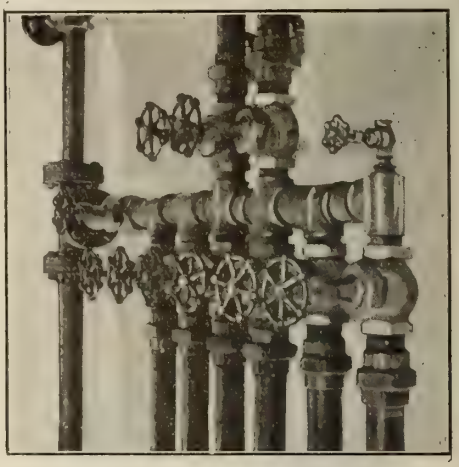
11. Hexagon lead pencil—The Cling-Surface Co.

In addition to these, picture cards, cigars, etc., formed appropriate and acceptable souvenirs, often and largely distributed by every representative.

VULCAN SOOT CLEANER INSTALLATION.

Among the labor and fuel-saving wrinkles which have been adapted by the Grand Trunk Railway for their boiler room at the new Chateau Laurier Hotel, Ottawa, is the Vulcan Soot Cleaner. As their boiler installation consists of four 250 H.P. Wickes Vertical Water Tube Boilers, this represents a new development in dealing with the soot problem, being the first water tube boiler plant in Canada so equipped with Vulcan Soot Cleaners, and the first installation on Wickes Vertical Boilers in any country.

We illustrate herewith the header containing the valves by which the Vulcan is operated. The valves are connected by risers, with interior arrangement of heavy pipe drilled in such a way as to blow with the draft, and remove the soot from the tubes and combustion chamber. When the steam pressure is off, by a simple arrangement of air-vents, a very slight current of air is admitted through the pipes. Oxygen thus admitted at all points increases the combustion of carbon monoxide gas, be-



Vulcan Soot Cleaner Header.

sides filling the purpose for which it is intended, i.e., to prevent the burning-out of the pipes of the cleaner.

EXHIBITORS CONVENTION SOUVENIRS.

CONVENTION SQUIBS.

By Johnny on the Spot.

Who said the engineers were stationary ?

Stratford's 72 hours full power trial went through without a hitch.

W. G. Walters was one of the two busiest men in Stratford during convention time, and to his courtesy and attention to everybody, much of the credit for the successful outcome is due.

As the 5.25 train pulled out for London on the Thursday afternoon, our ears caught the refrain—"Please don't take

The Operating Engineer's Ideal and its Attainment*

By Peter Bain**

The Measure of the Efficiency of any Society is the Extent to Which the Enthusiasm of the Individuals Composing it is Maintained Through the Organization, and Not Through the Personality of the Men at the Head of it. Want of Realization of This Foundation Principle Affects Materially the Progress and Work of Betterment, Constituting the Original Ideal.

THE purpose of this Canadian Association of Stationary Engineers as expressed in the preamble to its Constitution, may be divided under two heads; that which it won't, and that which it will do or countenance. "The promotion of educational, professional and mechanical knowledge" belongs to the latter, and to it, my subject, "The Operating Engineer's Ideal and its Attainment," will more particularly relate. I do not propose to overhaul and reiterate the time-worn theme that engineers lack education, and that if due attention was given this feature, all would be well. The risk of some brother rising to his feet, and leading the audience to sing in chorus, "Tell me the Old, Old Story," is a contingency I prefer to avoid.

Much Similarity of Ideal.

The operating engineer's ideal has a strong resemblance to that of men belonging to other trades and professions, is at rock-bottom, the desire to at least make a comfortable living, and shine if possible, as a star craftsman in addition. Some 14 or 15 years ago, there happened in the Old Country, what is known as the "Engineers' Strike." This particular occurrence, although not the first and only of its kind, so far overshadows the others as to lay claim to the title given. In spite of the widespread adhesion to "strike orders," a few men, non-union and union, continued to work. Among the methods adopted, to bring pressure to bear on these latter, who, by the way, were men well past middle life, was that of poem leaflets. A verse of each poem was specially directed to each man on duty, and of the lot, more or less appropriate perhaps, only one has remained to the writer's memory. It ran thus: Faithful Tom, he is growing old, With the love of work and the greed of gold, etc.

We are all built much after the fashion of "faithful Tom," and like him, we cannot be seriously blamed. Dollars and cents, however, you will note, constitute the reward of our love of work, and to most engineers, so long as they feel they are getting a "fair show" in the matter of salary, "the love of the work" is supreme. Men so endowed, while altogether rare, in what may be termed a public capacity, are in the writer's experience more plentiful than usually credited, and the process of drawing such men "out of their shell" as it were, is an ideal that this association should more and more endeavor to aim at.

While true of the Association, it is as much so of the men themselves. Self-consciousness sits heavy on human nature generally, and a false dignity which prefers to remain ignorant of desired information close at hand, is an inherent disease, with which we are all to some extent afflicted. No man knows the business from A to Z, although some feel and act as though they did.

The Stress of Competition.

To-day in every sphere of life, there is struggle, and whether admitted or not, we, as engineers, are in the game. There is battle between man and man, between trade and trade, and the operating steam plant engineer as an individual in the former case, and through his association in the latter, is being put right up against it. We may not expect a cessation of that jealous rivalry, by which one man seeks honorably to get ahead of his fellow, but we do expect him to control his self-centred policy to the extent that he is not altogether forgetful of his duty and obligations to his association. It is incumbent on every stationary steam plant engineer to keep himself constantly aware of, and alert to the efforts of competitors in other fields of power generation. The fact that steam is yet, and may continue to be the prime element for that purpose is being seriously challenged, and studied or careless indifference to the outcome, may operate hard, in regard to results.

Electricity, generated by other means than that of steam, oil or gas, to wit, by water power, is spreading itself by active propagation, and does not hesitate to claim that everything outside of that particular method is doomed. Hydro-Electric power is being boosted and must be reckoned with, and you engineers are among the men who will be required to square accounts. Seeming uncertainty exists as to which is the more economical, and shrewd, clever exponents of Hydro find no difficulty in proving its superiority in many cases, simply because those operating, are not fully alive to and getting the best out of their particular steam plants. In all large centres, many steam power plants are as silent as a graveyard, and the silencing process is still going on. You do not sufficiently realize that care in handling, and competence in overhauling, are mere commonplaces to-day, and that expert knowledge and persistent investigation to improve past records, are the all-essential. "Letting well alone" is simply shutting your eyes to progress and betterment, and giving the other fellow an opening. To offset all this, each engineer should have an ideal, even if impossible of attainment, and having it, he should make sure that it is given prominence and publicity.

Requirements of Your Ideal.

Education is the acquirement of knowledge, and need not be imparted through specialized courses in technical schools, papers or books. These are each desirable, and do much to facilitate progress, but if they be the sole and only means adopted, the effort will be found sooner or later a burden to be dropped. To keep pace with engineering progress to-day, and be truly educated to it, means personal application to, and investigation of, not only your own problems and troubles, but those of others in your profession. If you are having no trouble in your plant, it is not necessarily due to everything being properly tuned-up, or to your capacity for managing it.

The son of a well-known engineer, each of whom are now deceased, remarked to his father, that some new mechanism designed by him, (the son) would be a winner. The father did not quite see it in that light, and the son to help convince him, ventured the remark, "that it would work." The father's retort "that any damned thing will work" seems to me very suggestive, and probably appropriate to our subject. Mere contentment, because the plant operates to our and its owner's satisfaction, is no guarantee that we are anything more than a species of useful attendant. A power plant is not complete

*Paper read at the C.A.S.E. Convention, Stratford, July, 1911.
**Editor, "The Power House."

because an expert designer, a reputable manufacturer, and a capable erector have contributed to put it in service. The real completion rests with the operator, for he it is who has opportunity to note the imperfections arising from the labors of these others, and be called upon to rectify them by personal application or recommendation. Most plants have initial defects, some more than others, and there is usually no need to look for trouble beyond these. No plant is so perfect in its operation, that the ingenuity of the engineer may not find an opening to further improvement, and none are so hopelessly out-of-date, but encouraging results may be derived.

Personal Recognition in an Ideal.

The operating engineer is, therefore, the complement of the designer, the manufacturer and the erector; an ideal surely sufficiently high and attractive to strive after. To help attain to it, you must of necessity become familiar with the principles entering into the design, the methods of construction and the considerations affecting erection and operation. Book and Instruction Course education is for the most part shy on these points, therefore, to succeed, encourage questionings in your mind, cultivate personal research and investigation, and if satisfaction from these is not forthcoming in a reasonable time, or if your conclusions are subject to doubt, ask until satisfied.

Most of us take a pride in being asked questions, although, at times, we get cornered, yet if this did not happen, and afford us the opportunity to investigate, the worse fate of ignorance would remain to us. To those possessed of more than average knowledge of their business, I would suggest a full and free display of it in lecture, and question and answer nights in your various association lodges, and to those who need the information, a "throwing-off" of all diffidence and fear of wounded pride. From an experience of teaching classes in steam engineering, boiler firing, mechanical drawing, machine designing and workshop arithmetic, for 8 years in the City of Montreal, I received myself an education of surpassing utility, and nowhere attainable otherwise. Further, I found that operating engineers had many questions to ask, direct answers to which were unobtainable in books, or if so, were less effective than those given in person. From the foregoing, it became apparent that desire to know and investigate the problems of their various plants, was an ever-present and live issue, and methinks the ideal exists were the means of attaining it more at hand.

Graded certificates will do much to inspire effort towards "the operating engineer's ideal and its attainment," which, while beneficial to the employee directly, will also have a wide and far-reaching effect in the relationship existing between him and those he serves.

Corrosion Resistance*

By William Vaughan.**

CORROSION may be defined as the effect produced upon metal by the combined action of air and water, with or without the stimulus provided by the various impurities in the water or in the atmosphere. These corrosive effects are explained on the basis of chemical action alone, or that of electro-chemical action, caused by stray electrical currents from an outside source or by galvanic action, and due either to included impurities, or to the varying proportion of the different elements constituting the alloy.

The main diffrence between the two actions is in their intensity; the corrosive effect being practically the same in both cases, unless abnormal results are produced by high current densities. What takes months under the first condition, can be accomplished in six or eight hours by the second. Accelerating the chemical action by an electric current, gives therefore a comparatively simple method of determining the relative resistance to corrosion of the various metals. The correspondence between such laboratory tests and tests under practical service conditions, is established by the results of a service test here described.

Results From Service Test.

On May 15, 1909, nine different kinds of tubes were installed in a surface condenser, twenty-five of each kind being inserted in vertical rows and designated alphabetically by punch marks at the top of the row. The remaining tubes in the condenser, some 3,400, were of "admiralty metal" (untinned), having the following composition: Copper, 70 per cent.; zinc, 29 per cent.; tin, 1 per cent.

In all cases, failure took place by severe pitting and grooving running lengthwise of the tubes, while many showed small holes penetrating through the entire tube thickness. A large percentage of the failures showed on tinned tubes and was probably due to the electrolytic action set up between the metal and the tin, wherever defects occurred in the tin coating.

The pure copper tubes were particularly susceptible to corrosion, while the copper zinc tubes were much more resistant. The 60-40 and 66-33 tubes showed practically no difference, as was to be expected; there being little variation in corrosion found by the "electrolytic method," previously referred to, between brasses of these compositions. The so-called "admiralty metal" appeared to resist corrosion better than other brasses, and this too was indicated in the experiments, as the addition of a small amount of tin tended in most cases to diminish the rate of deterioration.

A large amount of experimental work still remains to be done on the numerous alloys manufactured to-day, but it is believed that investigations are being carried out to such an extent, that in the not distant future, the employment of alloys which are rapidly destroyed by corrosion will be due to carelessness or willful intention, and not to lack of proper information.

*Paper read before the American Brass Founders' Association.

**Of Arthur D. Little, Ins., Boston.

EXPLOSION IN POWER PLANT AT SASKATOON.

ANDREW G. SANGSTER, superintendent of the city power plant, Harry Johnson, chief engineer, and John Kemp, fireman, received terrible scalds when a tube in one of the boilers at the power house exploded on the afternoon of 27th July. The boilers, three in number, one of the water-tube type, on one side of the boiler-room, are connected with each other, and have a total capacity of four hundred and fifty horse power.

The bursting of the tube in the central boiler was, therefore, the precursor of a rush of scalding water and superheated steam, which emptied in a few seconds the whole three boilers.

About 12.30 p.m. it was deemed necessary, on account of the boilers leaking heavily, to withdraw the fires. Jack Sullivan, a coal wheeler, had scarcely started on that task when the tube blew out and hurled him, by the force of the preliminary rush of steam, away from the fire-hole and over a coal pile. He miraculously escaped injury, except for a number of bruises and a scratched wrist. The combined rush of steam which followed from the three boilers through the one aperture, next involved the superintendent, the engineer, and the other man with terrible results, the flesh being scalded almost off Mr. Johnson's arms and hands, and hanging only in shreds upon his fingers, whilst his head was also badly scalded and the whole of his body generally injured. Mr. Sangster's injuries, though not so serious, were also very bad, his arms and hands having been mainly subjected to the outburst of steam and water. Mr. Kemp received slighter injuries, and after having them dressed, was conveyed to his home in Mayfair.

As a result of the explosion, the whole power generating plant was shut down.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV AUGUST, 1911 No. 8

THE STRATFORD CONVENTION.

THE Convention of the Canadian Association of Stationary Engineers at Stratford in the latter part of July, will rank among the most successful yet held. Enthusiasm in the work of their Association was a marked feature displayed by the various delegates, and its effects had a large and important bearing on the various entertainment, social and educative programmes provided on their behalf.

The local lodge, its officers, the town's people and the different manufacturers, vied with each other in the warmth of welcome bestowed, and this, coupled with the efforts of the Exhibitors' Association, in not only putting on show their latest in power plant equipment, but in addition catering to the edification and amusements of all, left nothing to be desired.

Everything points to the growing power and popularity of the Canadian Stationary Engineers' Association, and rumor is already responsible for the statement that Belleville, the convention stand in 1912, is moving to make a still greater impression.

UNIFORM PROVINCIAL BOILER REGULATIONS.

In the section devoted to "Practical Articles by Readers" will be found a letter relating to the necessity for the regulations regarding steam boilers being put on a uniform basis throughout the Dominion. The writer shows that steps were taken to secure this, that some Provinces are operating in conformity with the arrangements and conclusions arrived at, and that others are not.

If for no other reason than an economic one, the laxity of the offending Provinces should not be longer tolerated. The construction, testing and inspection of steam boilers has reached a high state of perfection, and those responsible for all of these features are or should be men of sufficient sound sense, intelligence and reason to see and know that an All-Canada code of requirements is the most satisfactory. Mergers and consolidation of interests are prominent in every sphere of commercial and manufacturing life to-day, and from every point of view, that referring to steam boiler regulations, has still more to commend it, than have these.

Boiler manufacturers and operators alike have an interest in the consummation of this uniformity, and each should see to it being brought about.

PRACTICAL ARTICLE CONTRIBUTORS.

Readers will please note that considerable space in this issue is devoted to articles contributed by operating engineers, and that increased accommodation in this respect will be available each month. The field from which material may be drawn is unlimited, and the capability to supply that material is also unlimited and diversified. Different men see things from different points of view; what one sees another misses altogether, and while one is operating a water power plant, another a steam power plant, another a gas power plant and another an oil power plant, it should be remembered that each has a desire to know about the other's troubles, achievements and experiences, and by no more effective means can this be obtained, than by each telling his little story periodically in the pages of "The Power House."

WATER SOFTENING AND FILTRATION.

IT is unnecessary to discuss which is of greatest import, because water purification for domestic, manufacturing or steam-raising purposes is a leading and much-evident proposition.

We have recently had the opportunity of going into some facts and figures embracing all of the above-mentioned spheres in which water bears a prominent part, and have come to the conclusion that loss of life in the domestic realm, want of perfection and purity of product in many manufactures, and poor economy so apparent in many steam plants, are largely due to impure, unfiltered and unsoftened water.

It is to be observed, however, that a more widespread realization of the importance of this water softening and filtration question is growing, and that money spent in its accomplishment, whether by municipal and manufacturing corporations for domestic or business purposes, will prove not only a humane, but profitable investment as well.

The introduction of water softening and purification equipment is a requirement of every power plant for boiler feed purposes, eliminating, as it does, the possibility of scale adhesion to heating surfaces, the tendency to corrosion of the vitals of the boiler, and the risks of engine damage through foaming. Scale adhesion to heating surfaces means an increase in the fuel bill, in amount proportionately, as has been authoritatively proved, to a loss of 13 per cent. with surfaces showing scale of 1-16-in. thick.

In addition to the cash loss due to an increased and unnecessarily high coal bill, there is to be reckoned the cost of labor in keeping the scale within what we are pleased to term reasonable limits, by periodical chipping. This periodical removal of scale is just one of the things that the power plant staff do not look forward to with any great degree of pleasure, and, therefore, operators, as well as owners, should bear a mutually aggressive part in bringing about an improved condition of affairs by adopting some reliable method of purifying and softening the water supply of steam generation.

Cost of Steam Power in Ontario, From Actual Performance *

By J. O. B. Latour**

The Data Furnished in This Article is Worthy the Careful Consideration of Every Operating Engineer and Manufacturer. Power Generation is a Live Engineering Proposition To-day, and all Available, and at the Same Time Reliable, Information on Every Phase of the Subject is Therefore Welcome. Steam Power, Which We Have Come to Consider as the Manufacturer's Trusty Henchman, is Treated by Mr. Latour With Characteristic Thoroughness, in Simple, Intelligible and Instructive Language, and is, Otherwise, Commendable Because of its Personally-vouched-for Accuracy.

THROUGH the aggressiveness of gas engine manufacturers and hydro electric companies, the cost of power for manufacturing becomes a most interesting subject for the power user, the steam engineer and engine builder. Hydro electric power has been developed to such a stage of reliability, that it must be reckoned with. The good results have been obtained by making the apparatus necessary for such power, with the utmost care for economical and reliable operation.

Gas engines operating on producer gas are highly economical, and have been developed to such a stage of reliability, that they also must be admitted as permanent prime movers wherever the conditions are favorable. The large supply of good natural gas which favors several counties in this province, also plays an important part in the production of power. It is sometimes applied direct to gas engines, and oftener simply replaces the coal as fuel for generating steam.

The thoroughness of information as to the cost of operation of hydro-electric motors as well as gas engines, has aroused the power user to enquire into his power costs, which up to this time had been looked upon as a necessary evil at so much a year, without hopes of improvement. The more this subject is discussed, the more interesting it becomes. The engine manufacturer is being stirred into real activity to improve the cost of operation. At one time, his energies were spent in reducing cost of manufacturing and selling steam machinery. As a consequence of the power user being educated by competitors, the steam engine makers are adding experts on economical operation to their staff, with the result that much improved operating conditions are now apparent.

Cost of Steam Power.

I will confine myself to the cost of steam power only, as other types of prime movers have an abundance of exponents, besides, my long connection with steam engineering in this part of the Province especially, has enabled me to quote records from actual daily performance in varied kinds of manufacturing, and from this data I will base operation costs. The capital charges are based on the average cost price of the equipment enumerated, and quoted by engine and boiler manufacturers doing business in this locality. Building costs are average prices from plants already erected. All examples are from plants operating 10 hours per day, 300 days per year. The life of a steam engine is taken at 25 years, which makes a depreciation charge of 4 per cent.; boilers can be depended on for 20 years, which makes a depreciation charge of 5 per cent. Buildings are charged 3 per cent. depreciation, taxes 1.5 per cent. on ¾ of total cost, insurance 0.5 per cent. on total cost. Interest 5 per cent. on total cost.

* Paper read at the C. A. S. E. convention, [illegible] Ont. July, 1912.

** [illegible] engineer, the Canadian Casualty & Boiler Insurance Co., Toronto.

Example I.

100 h.p. high speed automatic engine, noncondensing, size 12 and 12 inch x 300 r.p.m., having 1-72 inch x 16 feet horizontal tubular boiler built to carry 135 lbs., according to the requirements of the different classification organizations, smoke connection from uptake to chimney, 1 open feed water heater, 2-5½ x 3½ in. x 6 in. boiler feed pumps, steam and water piping including erection, $2,780. Foundations, boiler setting, brick chimney, brick boiler and engine house, $2,550.00 . Total cost, $5,330.00.

Interest on the whole cost @ 5 per cent.	$266.50
Depreciation on buildings @ 3 per cent.	36.00
Depreciation on engine @ 4 per cent.	48.00
Depreciation on boilers, etc. @ 5 per cent.	79.00
Taxes	59.96
Insurance	26.65
Total yearly, fixed charges ..	$516.11
Engineer and fireman, 1 man @ $15.00 per week	780.00
685 tons coal @ $3.25 per 2,000 lbs.	2,226.00
Oil, waste, packing compound, etc., average of 7 years ..	187.50
Repairs, average 11 years..	67.30
Total operation one year ...	$3,260.80
Gross operation 1 year	3,776.99

Exhaust steam for heating 342,586 cu. ft. of factory was used when necessary; cold nights and mornings live steam was used, also a small quantity for manufacturing purposes. The coal charged, includes this. All this work has been estimated by comparison with factories using steam for heat, but not for power, which averages 1.2 lbs. per cu. ft. or 342,586 × 1.2 × 3.25÷2,000

equals	$668.04
Cost 1—80 h.p. boiler for heating, including setting, stack, building feed pump, etc., all ready for work @ $25 per h.p.	$2,000.00
Interest on same @ 5 per cent.	$100.00
Depreciation @ 4 per cent. .	80.00
Taxes 1½ on ¾ cost	22.50
Insurance	10.00
Total fixed charges	$212.50
Fireman 30 weeks @ $9.00 per week	$270.00
Repairs and Miscellaneous ..	75.00
Coal as above	668.04
Yearly operating charges	$1,013.04

These quantities must be credited to the gross power costs as they would be required with any other type of prime mover, resulting as follows:

Net cost of power plant, $5,330—$2,000 equals	$3,330.00
Interest, depreciation, taxes, insurance as yearly fixed charges, $516.11 — $212.50 equals	$303.61
Operation, $3,260.80—$1,013.-04 equals	$2,247.76
Making a total yearly net cost for power	$2,551.37

The load of this engine for 10 hours averaged 80 i.h.p. with a maximum of 97 i.h.p. and a minimum of 50 i.h.p. and is continually repeated daily. The boiler showed an equivalent evaporation from and at 212 degrees F. per lb. of combustible .... 11.08 lbs.

Inclusive of heating, the cost of power per i.h.p. is for operation per year.....	$28.10
For fixed charges per year....	3.79
Total cost per i.h.p. per year	$31.89
Total cost per i.h.p. heating not credited	$47.21

250 H. P. Plant Noncondensing With Exhaust Heating.

The next case is a 250 i.h.p. Corliss Engine 18 in. x 42 in. x 90 r.p.m. 2 72 in. x 18 ft. horizontal tubular boilers built to carry 135 lbs. according to the requirements of the different classification, organizations, smoke connection to chimney.

1—open heater

2—7 in. x 4 in. x 8 in. boiler feed pumps, steam, exhausr and water pipe inside of engine and boiler room including erection, $6,521.00.

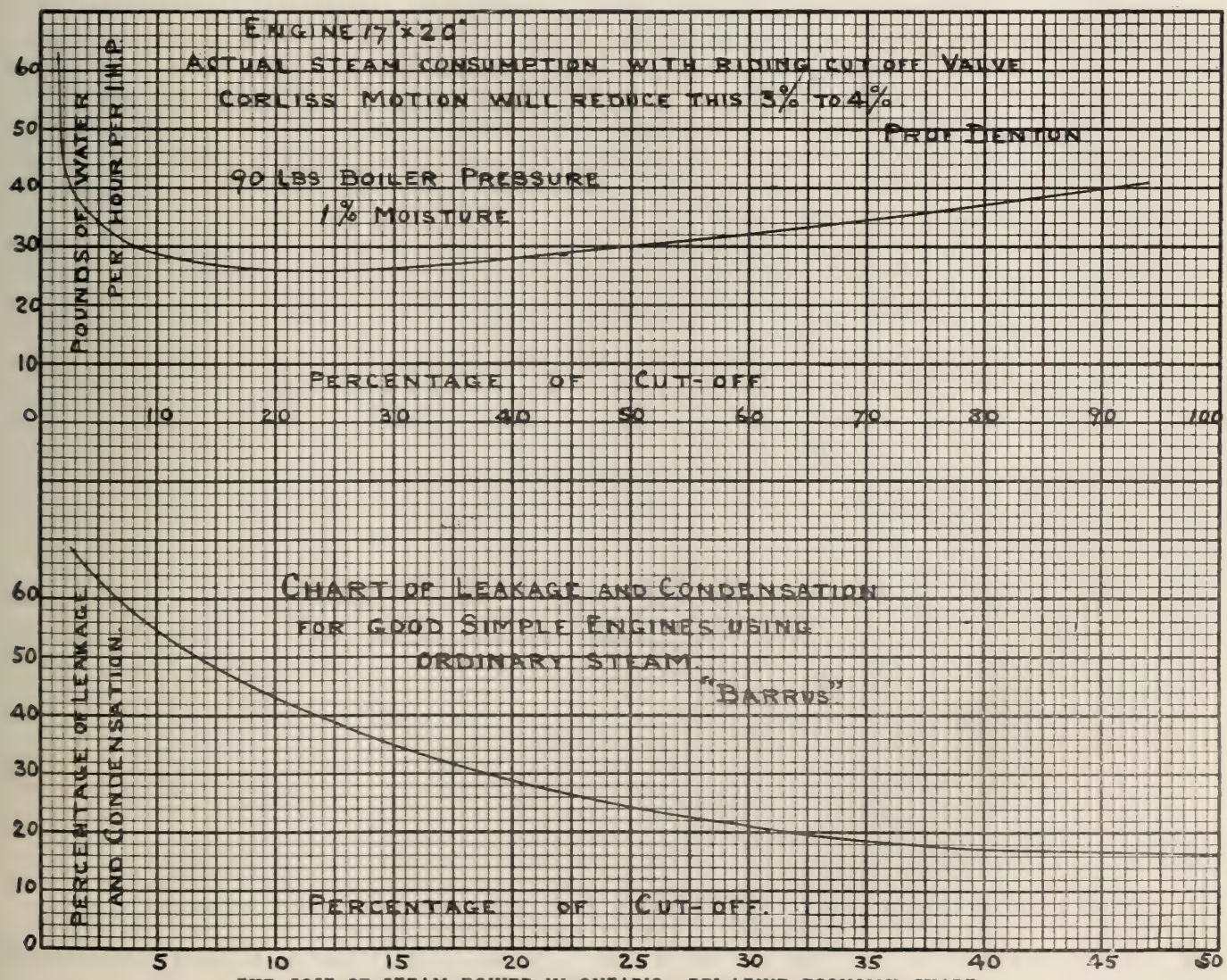
Foundation, boiler setting, brick chimney, brick boiler and engine house	$5,750.00
Total cost	$12,296.00
Interest on the whole cost @ 5 per cent.	614.80
Depreciation on buildings @ 3 per cent.	90.00
Depreciation on engine @ 4 cent.	124.00
Depreciation on boilers @ 5 per cent.	309.80
Taxes	138.33
Insurance	61.48
Total yearly fixed charges	$ 1338.41
Engineer @ $15 per week	780.00
One fireman @ $10 per week	520.00
1408 tons of coal @ $3.25 per 2000 lbs.	4576.00
Oil, waste, packing, compound, etc.	425.00
Repairs @ 2 per cent.	245.92
Total operation 1 year	$6546.92
Gross operation 1 year	7885.33

Exhaust steam for heating 1,020,500 cu. ft. was used when necessary. Cold nights and mornings live steam was used, also a small quantity for manufacturing purposes. The coal charge includes this, the credit for exhaust steam will be 1,020,500 multiplied by 1.2 multiplied by 3.25 divided by 2,000 equals $1,989.97.

Cost 2—100 h.p. boilers for heating, including setting, stack building, feed pumps, etc., all ready for work @ $25 h.p.	$ 2500.00
Interest on same @ 5 per cent	$125.00
Depreciation @ 4 per cent.	100.00
Taxes 1½ per cent. on ¾ cost	28.12
Insurance	37.50
Total fixed charges	$ 290.62
1 fireman 30 weeks @ $12.00 per week	$360.00
Repairs and miscellaneous	150.00
Coal as above	$1989.97
Yearly operating charge	2499.97
Crediting power with those quantities as previously	
Net cost of power plant $12,296.00—2500.00	$9796.00
Interest, depreciation, taxes, insurance, as yearly fixed charge $1338.41—290.62	1047.79
Operation, $6,546.92—$2,499.97	4046.95
Total cost per I.H.P. year	$5094.74

The load on this engine for 10 hours, averaged 204, minimum 141, maximum 219 and, practically repeated daily, taking it @ 200 I.H.P. the cost of power crediting with heating is,

Operation cost per I.H.P. 1 year	$ 20.22


ENGINE 17"x20"
ACTUAL STEAM CONSUMPTION WITH RIDING CUT OFF VALVE
CORLISS MOTION WILL REDUCE THIS 3% TO 4%
PROF DENTON
90 LBS BOILER PRESSURE
1% MOISTURE
POUNDS OF WATER PER HOUR PER I.H.P.
PERCENTAGE OF CUT-OFF
0 10 20 30 40 50 60 70 80 90 100
CHART OF LEAKAGE AND CONDENSATION
FOR GOOD SIMPLE ENGINES USING
ORDINARY STEAM.
"BARRUS"
PERCENTAGE OF LEAKAGE AND CONDENSATION
PERCENTAGE OF CUT-OFF.
0 10 20 30 40 50 60
5 10 15 20 25 30 35 40 45 50

THE COST OF STEAM POWER IN ONTARIO—RELATIVE ECONOMY CHART.

Fixed cost per I.H.P. 1 year ...	5.24
Total cost per I.H.P. 1 year ...	25.47
Total cost per I.H.P. heating not credited	39.43

280 H.P. Plant Compound Condensing.

1 Corliss long range cut off tandem compound condensing Girder frame 16 and 30x36x80 R.P.M.

1 steam-driven jet condenser 10x14x18

1 Duplex steam pump 6 x 3½ x 6

1 Duplex plunger power boiler pump

1 Injector

1 Open heater

2-72x16 ft. Horizontal Tubular Boilers with Jones Underfeed Stokers

1 live steam water purifier, including erection ....$	8960.00
Foundations, boiler setting, brick chimney, brick boiler and engine house	6450.00
Total cost ....$	15,410.00
Interest on the whole @ 5 per cent. ....$	770.50
Depreciation on building 3 per cent.	112.00
Depreciation on engine 4 p.c. ...	139.50
Depreciation on boilers 5 p.c....	388.00
Taxes	173.36
Insurance	77.05
Total yearly fixed charges ...$	1,660.41
Chief engineer @ $17.50 per week, 50 per cent. to be charged to mill as master mechanic	455.00
1 shift engineer @ $13.00 per week	686.00
Common labor	100.00
889 tons coal @ $3.20 per 2,000 lbs.	2,844.80
Oil waste, packing compound, etc.	323.50
Repairs 9 years average	257.60
Total operating 1 year .....$	4,666.90
Gross operating 1 year .....$	6,326.31

The load curve of this engine is 85 per cent., minimum 77 per cent., maximum 90 per cent. The average I.H.P. is 238 determined by several tests. The water evaporated per lb. of coal is 8.97 lbs. The temperature of the feed water is 194 degrees F. steam pressure 115 lbs. The steam actually accounted for by the indicator diagram is 85 per cent. showing the steam valves and pistons to be tight. All piping containing steam or hot water is perfectly tight and well covered. I have known this plant for several years and never saw any difference in this respect. There is some live steam heating done when necessary. All returns are trapped to the open heater. The coal charged is included in this.

Cost operation per I.H.P. per year ....$	19.56
Cost all charges per I.H.P. per year	26.58

It may be well here to draw your attention to the fact that the above examples are in the minority and are the best examples I could select from those I have made up. However, there is no reason why all should not be able to do the same .

Some Plant Conditions.

As an example of probably an average condition, here is a plant with horizontal tubular boilers in good condition, 4 valve releasing gear engine and 1 automatic high speed engine, open heater supplying feed water at 198 degrees F., all pipes covered, etc. The I.H.P. cost per year is $84.79. This plant is clean and discipline good. Another one with a 4 valve releasing gear engine, 2 horizontal tubular boilers, open heater, the cost of power is $132.60. This plant, probably as bad as can be found has every appearance of negligence the instant one enters the place.

Requirements for Economic Results.

Naturally the question arises what is necessary for economic results. A short answer would be "use all the steam you require and save the rest." Beginning with the boiler it must be set according to approved methods, the brick walls (if any) must be tight, the grates in good order and suitable for the fuel burned. Coal should burn not slower than 10 lbs. per square foot of grate, if it does not burn that much, reduce the size. Chimney must give ample draft. All pipes, valves, stop cocks and the various joints must be absolutely tight. are in many plants located in the most unreasonable place that can be dropped or lost. In many cases this will require the assistance of return traps to return to the boilers direct. All these traps must be kept tight and their mechanical movement kept free. The steam and exhaust valves and piston of the main engines must be tight. Concerning the real steam consumers, the independent steam driven auxilliaries which consume from 90 to 150 lbs. steam per I.H.P. per hour when in fair running condition, I am sorry to say that in many plants they are placed in the most unreasonable place that can be found. There is absolutely no need for this condition in any plant. No more of these independent steam auxiliaries should be permitted in a plant than are required to supply sufficient exhaust steam to an open heater to maintain the feed near but not at the boiling point. If vapor escapes from an open heater it is a direct loss of heat. When a boiler is closed down after the day's run everything should be tight enough that the water remains practically at the same height when it is cold. All supplies should be put neatly into locked cupboards and rooms. Complete records of coal and all supplies should be kept. Occasionally the power delivered should be ascertained by indicating, also proper correction of the steam valves made if necessary, and costs determined, at least quarterly. The engineer should be supplied with this information and given to understand that he is expected to be interested in the results. The ever commanding feeling to excel in most men will develop to a surprising degree with its profitable results to all parties concerned. Do not forget that intelligent operating engineers and firemen are absolutely necessary for economy and reliability.

Engines and boilers are rated at the point that they can develop their power most economically. By examining the accompanying chart the difference in economy, by underloading especially, can be seen at a glance. The capacity for overload on engines can be taken at 25 per cent. for say a couple of hours daily if required, and 50 per cent. for momentary loads.

Trusting that this paper may assist to bring up steam engineering practice to better light.

Trade Gossip

The Robb Engineering Co., Amherst, Nova Scotia, and South Framingham, Mass., are building a return tubular boiler 48 in. by 12 ft. for C. O. Nichols, Somerset, N.S., and a boiler of the same type, 42 in. by 12 ft. for the Veniot Wagon Co., Ltd., Bridgewater, N. S. With the last order is included an 8 by 8 inch engine and stack.

The Campbell Gas Engine Co., Ltd., Halifax, England, are exhibiting at the Toronto Canadian National Exhibition. Their Mr. Moscrop is at present in Toronto, and can be seen by appointment, with regard to representation in the various provinces of the Dominion. All correspondence should be addressed, the Campbell Gas Engine Co., Ltd., Machinery Hall, Exhibition, Toronto.

George H Tod, Manning Chambers, Toronto, is now Canadian representative for the Bennis Stokers, John Musgrave & Sons, Bolton, engine and steam turbine manufacturers, and the Broadbent Cranes. All of these are leading English concerns in their particular lines, and maintain a high record in quality of production and subsequent operation attainment. Mr. Tod is at present on a business trip in the Maritime Provinces, and during his absence Mr. Goodwin, who recently joined the sales department, is attending to inquiries and orders.

Power Plant Troubles, Happenings and Improvements

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

Corliss Valve Gears

THE ordinary type of admission valve gear on Corliss engines, depends on a spring to overcome the effect of inertia upon the disengaging links. The faster the engine runs, the heavier this spring, and its pressure must cope with inertia and insure uniform latching. Hence, on a high speed engine, severe wear is incurred on the rollers or guides, holding the latch to its path, and at the same time, a heavy reaction is transmitted to the governor. The springs, rollers and various devices, therefore, must be given constant care and adjustment, or they will become noisy.

New Type Admission Valve Mechanism

A new type of admission valve mechanism, styled the "inertia gear" by its designer, Ernest A. Moore, chief engineer, the Bates Machine Co., and regularly used on all Bates Corliss engines, is offered, to overcome such inherent faults of existing types of admission valve gears. With this "inertia gear," the disengaging parts, instead of being forced into and held in their path by springs, rollers or other devices, travel in the desired path by natural forces involved in the movement. Referring to Fig. 1, the dash pot arm is in the form of a bell crank, one leg carrying the dash pot rod, and the other the catch block. The dash pot arm is keyed to the valve stem, and a sleeve on its inner side fits into a bored recess in the steam bonnet, thereby gaining large bearing surface. The steam arm has a liberal bearing surface on the bonnet, and is driven by the valve rod in the usual way. A substantial boss on the steam arm, carries the latch shaft, on the inner end of which is firmly mounted the knock-off bar, these two parts forming practically one solid piece of steel which pivots round the point "B." The knock-off ring is controlled by the governor, and carries the knock-off and safety cams. The latter comes into operation, only in the event of some mishap to the governor, the cam being thrown into such a position, that the valve cannot be opened.

Operating Movements.

The operating movements are as follows: On opening the valve, the valve rod moves to the left, the latch shaft engages with the block in the position shown in the sketch, and continues in this path, until the knock-off bar comes into contact with the knock-off cam, and is forced outward, raising the latch until the block is released. The dash pot then comes into action, and returns the arm with the block attached, to the original position. The follower pin is firmly fixed to the steam arm, and acts only in the event of the dash pot failing to close the valve. The construction and balancing of the latch shaft, and its knock-off bar attachment, are such that the inertia due to the reciprocating motion and the gravity of the parts ensures an automatic latching action at the end of the return stroke, between shaft and block, without the use of any spring, or other mechanical device, and in turn, assists the unlatching at the point of cut-off, thereby reducing reaction on the governor.

The depth of the latching, and amount of clearance of the catch blocks, may be set accurately, and with the greatest ease, while the engine is running full speed. This is accomplished by the two adjusting screws F and F.

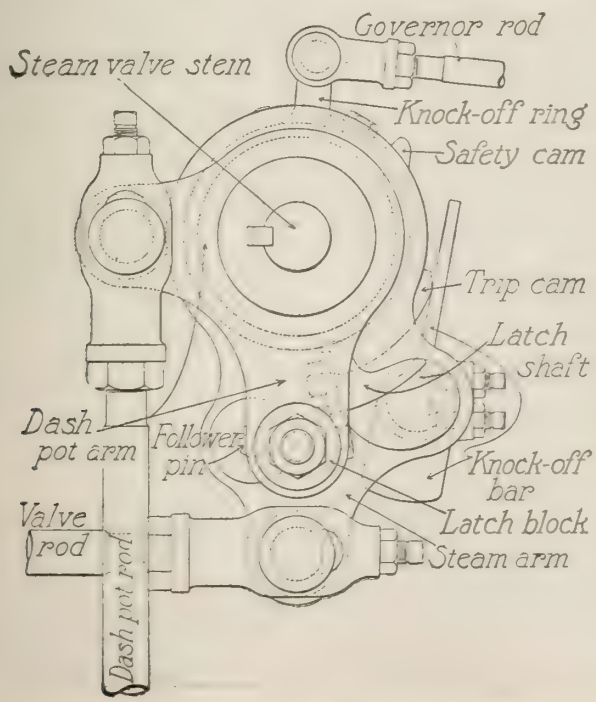


Fig. 1.

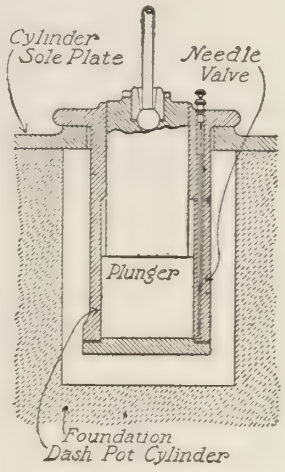


Fig. 2.

The gear has been thoroughly tested, and found to work positively and quietly, up to the limit speed of vacuum dash pots—over 250 r.p.m.

Special Dashpot.

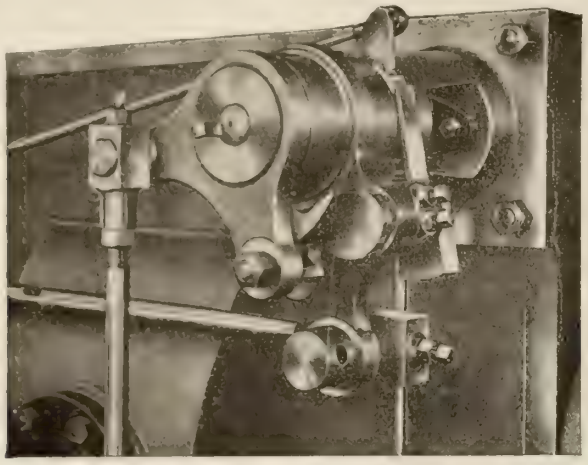
The dash pot used, is also of special design, and is claimed to be remarkable for quick action, noiseless operation and durability. It is set beneath the soleplate, is made without packing or leather of any kind, and the method of cushioning, enables it to act over the wide range of lifts without requiring adjustment.

Referring to Fig. 2, the dash pot cylinder and plunger are of two diameters, with ground fit on each. With the plunger at lowest position as shown, there remains an annular internal chamber, full of air. An air passageway is provided from it, to a point underneath the plunger, and the area of this passage may be varied by the

needle valve, to regulate the amount of air transferred to the lower chamber. In operation, the air is displaced from the annular to the vacuum chamber below the plunger, exactly in proportion to the lift of the pot, the air forming a cushion. The cushioning effect is, therefore, always proportionate to its work, and the air is driven back and forth within the pot, noiselessly, instead of escaping to the atmosphere.

Noiseless and Positive Action.

These improvements in gear and pot make for noiseless and positive operation of the valves at slow speeds, and their success in these respects is greater as the speed increases. It is claimed by the makers to be the quietest Corliss gear yet produced, all noise having been eliminated, except that of the actual contact of the latch blocks. The improvements have been attained by practical, simple construction, compact and accessible. With a view to keeping as nearly as possible in line, all working strains in the valve drive, both steam and exhaust drives, are fitted with a telescopic detaching device, to enable the valve gear to be worked by hand.



Corliss Engine Valve Gear.

Overcoming Peak Load Troubles

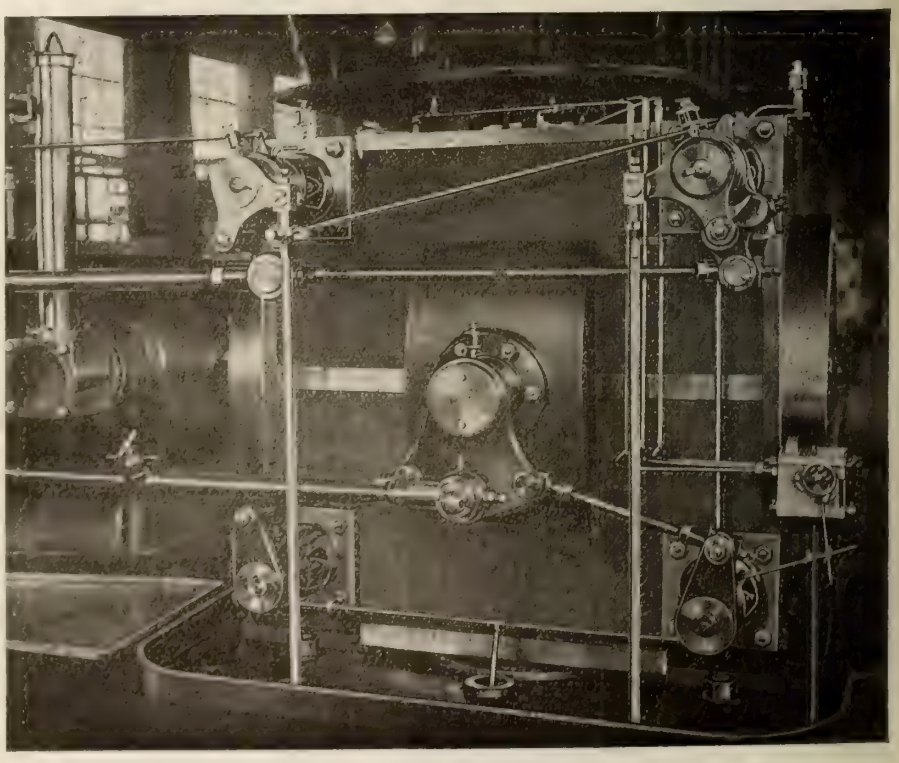
USERS of electric power are sometimes compelled to buy on a "peak load" basis, that is, not exceeding a fixed current consumption at any time during the year, but paying constantly for that fixed maximum, regardless of how much current is used. On this basis of payment, it is evident that continually running close to the specified limit or vice versa, keeping the current consumption low at the time of greatest load is advantageous. The former procedure is impossible in many manufacturing processes, it being in lighting and street railway work, that the latter is usually attempted by using storage batteries.

Novel Solution.

Those who have studied this peak load problem will be interested in a novel solution, which has been quite successful in the municipal lighting and waterworks plant of the City of Lachine, Canada. In this instance the low cost and satisfactory operation of a 400 h.p. steam turbine unit is utilized in effecting the economy. In the Lachine plant a 14-inch two-stage double-suction turbine pump, having a capacity of 6,000,000 gallons per 24-hour day, is utilized to provide water supply and fire protection for the city; the water pressure being ordinarily 80 pounds per sq. in., and for fire 120 pounds per sq. in.

Current is purchased by the year, on a basis which is all right for lighting the city, and for pumping at all times of the year, except the three winter months, during which the lighting load is greatest. It was figured that operating the pump by steam for four or five hours a day during that period would be less expensive than buying sufficient electric current to operate entirely by electricity. As further advantages of an auxiliary steam instalation, the insurance rate on the pumping station would be reduced, and the city would be better lighted during fall evenings, without incurring unreasonable additional expense. It was therefore decided to arrange the pump for operation by a 400 h.p. induction motor during the greater part of the time, and by a steam turbine during the peaks of the lighting load in winter, and in case of accident to the electric line.

The instalation, furnished by the John McDougall Caledonian Iron Works, of Montreal, is shown in the accompanying photo. The pump, of Worthington make, runs at 900 r.p.m., is direct connected to an Allis-Chalmers-Bullock motor on one side and a 400 h.p. 4-stage Kerr turbine on the other. Either driving unit can be thrown into or out of use instantly by means of clutches on the shaft.



Corliss Engine Valve Gear.

Steam Required to Operate Underfeed Stokers

By C.T.R.

Auxiliary Machinery in the Power Plant, Using Live Steam From the Boilers, Has a Strong Tendency to Affect Detrimentally, the Over-all Economy of the Whole, Unless Careful Attention Has Been Given to Selection, Installation and Daily Operation. Mechanical Stokers Form a Prominent Feature in Many Boiler Rooms, and Steam Consumption Data Concerning These, as Contained in This Article, Will Doubtless be Appreciated.

WHEN the question of installing stokers in a power house is under consideration, it is often a matter of importance to know approximately the amount of steam which must be used for driving the stoker and forced draft apparatus. Many extravagant claims have been advanced for various types of stokers and blowers, although actual figures available have been decidedly meagre. The following data is therefore of particular interest to power station men, as showing with reasonable accuracy the amount of steam consumed by the fan engine of a Taylor stoker. The figures are the result of many observations and careful calculation, and show unmistakably, how insignificant this item of stoker expense really is.

To bring home this matter more strikingly, a concrete example has been assumed, and the figures obtained, based on these conditions, may be applied with certain reservations, to any installation of stokers of this type.

Stoker Operation Data.

Assuming, for example, a condition where the steam pressure is 150 lbs., the feed water temperature 150 degrees, and the make-up water 60 degrees. The fan engines will require for the delivery of 1,000 cubic feet of air per minute, approximately 2 brake h.p., inclusive of power required for feeding the coal.

Ordinarily, with a reasonably economical cut-off, the fan engines will produce a brake horse power under these conditions on 40 lbs. of steam.

$$80 \times 1{,}150 = 92{,}000 \text{ B.T.U.} =$$

the amount of heat in the steam over and above make-up water temperature. This represents the energy added to the water, a portion of which will be used in the development of sufficient power to move 1,000 cubic feet of air against a static pressure of 3½ inches of water, or sufficient air for the combustion of 300 lbs. of combustible per hour, or the evaporation from and at 212 degrees of 3,300 lbs. of water; equivalent to a total energy of 3,201,000 B.t.u.

If all the steam passing through the fan engines were exhausted into the atmosphere, the amount used would represent

$$\frac{100 \times 92{,}000}{3{,}201{,}000} = 2.9 \text{ per cent.}$$

There is available however, in this exhaust steam in an open heater with 5 lbs. back pressure, $80 \times .90 \times (1180-60) = 80{,}980$ B.T.U., 10 per cent. representing the loss due to condensation, etc., although a probable loss of 20 per cent. of this 80,980 B.T.U. in piping and heater inefficiency, would make returnable only 64,760 B.T.U. Therefore, 92,000—64,760=20,240 B.T.U., actually used for development of power on the fan engine, =

$$\frac{100 \times 20{,}240}{3{,}201{,}000} = .9 \text{ of 1 per cent.}$$ which

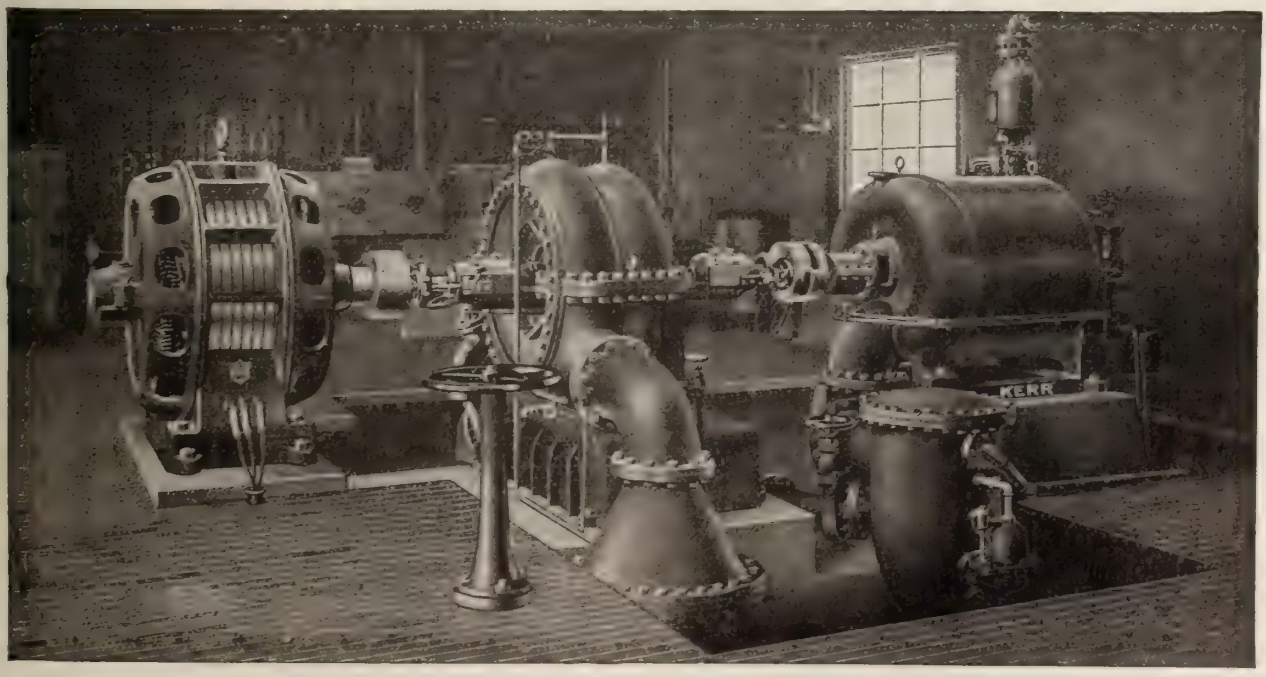
represents the actual percentage of the energy developed and required for operating the fan equipment.

Stoker Operation Data II.

At more efficient rates of combustion and lower air pressures, the loss becomes much less. With a heater of the closed type, 5 lbs. back pressure, and approximately 150 degrees feed water temperature, there is available $80 \times .90 \times (1180-150) = 74{,}160$ B.T.U., 10 per cent. as before representing the loss due to condensation, etc. With a further probable loss of 30 per cent. due to steam losses, piping losses and heater inefficiency, there are, therefore, only $74{,}160 \times .70 = 51{,}912$ B.T.U. actually returnable, being $92{,}000 - 51{,}912 = 40{,}088$ B.T.U. used for generating power, or

$$\frac{100 \times 40{,}088}{3{,}201{,}000} = 1.25 \text{ per cent.}$$

Fan engines need not take more than 2 per cent. of the steam developed, if efficient fans are used with economical steam units, and the stokers operated at somewhere near their most efficient rating. As a matter of fact, this percentage could be probably lowered.



MUNICIPAL LIGHTING AND WATERWORKS PLANT, LACHINE, P.Q.

Experiments With Francis and Tangential Turbines *

By Franz Prasil **

This Article Deals With the Development of the Francis Turbine and Pelton Wheel, and Shows That not Only are These Types Leaders in Their Particular Field, But that in Constructional Detail, Involving High Efficiency of Automatic Governing and Reliability of Safety Mechanism, There has Been a Steady Growth and Success of Their Operation, Wherever Adopted.

AT the Paris Exhibition in 1900, the direction in which the development of the design of modern water turbines had progressed in the last decade of the preceding century was clearly set forth The old systems of the Jonval and the Girard turbine had almost disappeared; the Francis turbine and the Pelton wheel in the most varied

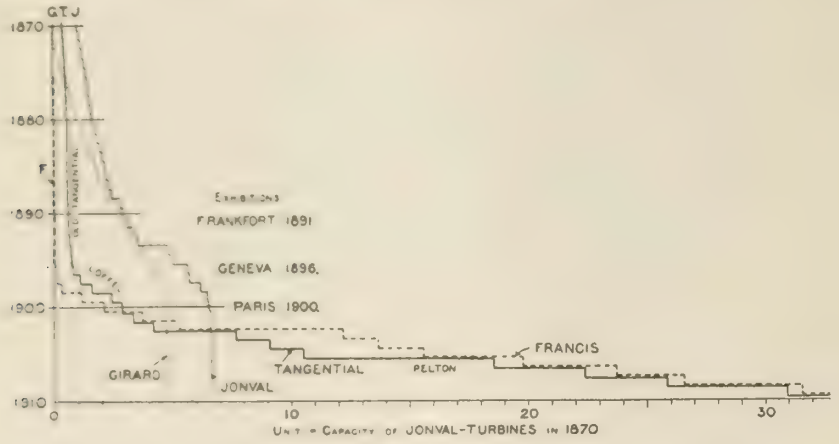


FIG 1.

forms of construction had stepped into their place, and the variety of these proved the importance that was attributed to these types. At the exhibition, it was indeed possible to recognize the great adaptability of the two types to local requirements, as well as to the demands of the most varied industries. The exhibits were not, however, subject to test, therefore a quantitative judgment of the merit of the designs was not possible.

The increase in the manufacture of Francis turbines and of Pelton wheels, in comparison with that of the old types, is shown in Fig. 1, prepared for the Swiss catalogue of the Interuational Exhibition at Turin, 1911. Since 1900 both types have developed in the direction of the increase of horse-power per unit, so that their sizes have now reached as high as 16,000 h.p. per wheel. The Francis turbine is applied with success to falls of from 1 to 150 m. (3.3 to 492 ft.); the Pelton wheel to falls of from 40 to 950 m. (131 to 3,116 ft.). In this are to be noted not only a steady improvement in the details of construction of the turbine, but also in the efficiency of the automatic governing and the safety-mechanism. Particularly for modern plants having long supply pipes and conduits with their severe specifications of high standard reliability in the safety apparatus, these requirements made large claims upon the skill and ability of the engineers. The result has been, however, a large measure of success in the production of successful designs.

The members of the Institution of Mechanical Engineers had an opportunity of inspecting various hydro-electric plants in Switzerland, and of having the details of their construction in this special respect explained either by the engineers in charge or by representatives of the turbine-makers. To the author there falls the agreeable task of presenting some comparative tables of the results of tests, which have been entrusted to him to carry out. He has endeavored in the tables and diagrams to follow such order and sequence as will make clear the influence of various arrangements of detail and proportions of dimensions. The experiments relate to installations which have been carried out at four works. The agreement of the results demonstrates that a condition of stability in the development of the design of turbines has been reached, and that we are now near the limit of attainable dynamic efficiency and perfection in governing. For the sake of concentrating attention upon the matter of the analysis, the naming of particular firms has been avoided.

Fall over Weir		Water Flow, Litres per second: By the Free Formula		By the Calibration Curves.		Difference: Litres per second.		Per cent.
Mm.	Inches	Litres.	Gal.	Litres	Gal		Gal	
93.8	3.693	65	14.3	67	14.7	2	0.4	3.1
98.1	3.862	70	15.4	72	15.8	2	0.4	2.9
104.6	4.118	77	16.9	79	17.4	2	0.4	2.6
119.4	4.701	93	20.5	95	20.9	2	0.4	1.1
132.5	5.217	109	24.0	111	24.4	2	0.4	0.9
170.6	6.717	161	35.4	162	35.6	1	0.2	0.6
178.9	7.043	173	38.1	174	38.3	1	0.2	0.6
216.2	8.512	232	51.0	232	51.0	0	0.0	0.0
247.4	9.740	285	62.7	287	63.1	2	0.4	0.7
273.6	10.772	334	73.5	336	73.9	2	0.4	0.3
295.0	11.615	376	82.7	379	83.4	3	0.7	0.8

B.—Water Measurement.

A.—Measurement of Fall,

(a) Direct Measurement.—In the case of low-pressure turbines in open wheel-pits, the level of the water in the head and tail races were read off directly by point-gauges, their difference giving the working fall. The gauge-points must be fixed as near the turbine as possible. Each of the two graduated staves slide in a vertical guide forming part of a securely fixed wooden frame, and the metal points moving with them are brought down until they just touch the water surfaces. The zero of the two scales is obtained by applying the points to the two water surfaces when they are still with a very small water-flow, the level-difference between these having been acturately determined by levelling instruments.

Water Consumption. Cubic Metres per second measured at Section. I.	II.	Difference. Cubic Metres per second.	Per cent.
4.790	4.615	+ 0.175	+ 3.6
4.630	4.650	— 0.020	— 0.5
4.040	3.960	+ 0.080	+ 1.7
3.610	3.680	— 0.070	— 1.9
2.600	2.794	— 0.194	— 7.5

Rotating Current Meter Measurements.

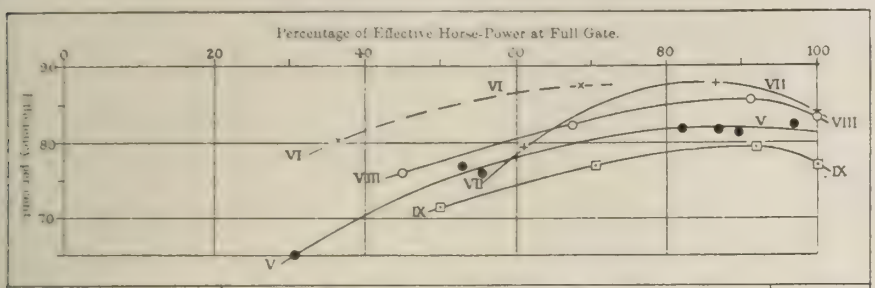
(b) Indirect Measurements.—If the water surfaces be inaccessible, a piezometer can often be applied for low-pressure turbines, on which readings similar to those above mentioned under (a) can be taken. With high pressure turbines having long supply piping and suction tube, the pressure-fall, or fall from supply to turbine level, can be measured by pressure gauge, and the discharge of suction fall, either direct as above, or by help of a vacuum-gauge. In the case of the Pelton wheel, only the pressure fall comes into question. The positions at which the pressure and vacuum-gauges should be attached to the supply and

* Abridged from the Zurich (Switzerland) [illegible] of The Institution of Mechanical Engineers, London, July, 1911.

** [illegible] of Engineering, Zurich, Switzerland.

discharge pipes must be as near the turbines as possible, and where as uniform as possible pressure distribution reigns over the cross-section of the water-flow. Readings from pressure and vacuum-gauges attached at or close to pipe-bends, or to the spiral casings of

(a) Weir Measurements.—These were in all cases carried out with sharp-edged weirs, specially built for the tests; in some cases arranged with side contraction, and in others without side contraction. The readings were taken by precision needle-gauges, with verniers read-



No.	System.	Fall in Metres.	Revs per Min.	Effective H.P. at Full Gate	a = per cent. of Full Load. b = per cent. Efficiency of the Turbines.								Measurement of Horse-power.
					a	b	a	b	a	b	a	b	
V.	Single horizontal axis	42·0	411	550	97·0	82·3	82·8	81·7	56·0	76·0	30·9	65·3	Electrically.
VI.	..	64·0	400	4000	—	—	—	—	68·7	87·4	36·6	80·5	
VII.	Double horizontal axis	60·0	496	2696	100·0	78·6	86·6	87·6	56·0	79·4	—	—	
VIII.	..	87·0	490	2620	100·0	83·5	91·5	85·6	67·5	82·2	45·3	76·3	
IX.	..	147·0	601	3458	100·0	77·2	92·0	79·6	79·5	77·2	50·0	71·6	

TABLE 2—EFFICIENCY OF FRANCIS TURBINES IN SPIRAL WHEEL CASES.

closed turbines. are inadmissible for this purpose of determining the fall.

B.—Water Measurement.

In the tests now presented, the water consumption was measured sometimes by weir and sometimes by rotating current meter.

ing to 1-10th mm. (1-250th inch). The calculations of the quantities were made either by the Frese formula, the derivation of which is fully described in the "Journal of the Vereins Deutscher Ingenieure" of 1890; or else directly from calibration-curves, obtained from rotating current meters by the Hydrometric Bureau of the Swiss Hydrographic Department.

From Table on page 228 may be seen to what extent the formula-calculated, and the calibration-curve results agree.

The weir investigated had a breadth of 1.19 metre (46½ inches), and had no side-contraction. We note the absolute difference to be nearly constant, and always of the same sign, therefore it may be concluded that either the formula or the current-meter had a constant error. For water consumption over 100 litres (22 gals.) per second, the percentage difference remains under 1 per cent.

(b) Rotating Meter Measurements.—These were carried out partly by Herr Dr. Epper-Bern, Director of the Swiss Hydrographic Department, and partly by the writer or other experimenters. The instruments used came from the workshops of Ott-Kempten in Bavaria; and were from time to time calibrated in the Calibration Laboratory of the Confederate Hydrometric Bureau. The technical mode of using was in all cases that prescribed by the Confederate Hydrometric Bureau.

From one series of tests, in which simultaneous measurements were taken at two cross-sections, the degree of accuracy of this mode of measurement, are shown by table on page 228.

Section I was in the smooth cement-finished part of the underground tunnel. Section II was in the rough stone part of the discharge channel into the River (Wildbach). With such difference of

No. of Turbine	System		Work Done.	Details of Design.										Test Results.											
				Base Data.				Runner Dimensions.						Fall in metres.	Revs. per Min.	Full Load. H.P.	Percentage of Full Gate Effective H.P.							Method	
				Fall in metres.	Water Flow m³ per sec	Revs per min	Full Load H.P.	Inlet. Diam. D metres.	Inlet. Breadth B. metres	No. of Blades.	B/D.	Peripheral Speed Velocity due to revs. $u = D\pi n/60$.	Velocity due to fall $C = \sqrt{2gH}$.				100	90	80	70	60	50	40	Water Measurement.	Measurement of Eff. H.P.
																	Percentage Efficiency.								
I.	Horizontal Axis, Vertical Axis I. II.	Single	Spinning Mill.	4·6	3·000	100	142	1·25	0·300	17	1:4·17	6·30	9·5	4·6	100	158·3	88·1	88·5	87·5	85·5	82·2	78·0	—	Rotating Current Meter	Prony Brake
II.		Open		4·4	4·940	100	220	1·30	0·435	17	1:2·95	6·82	9·3	4·4	100	260	82·5	87·0	87·2	87·0	84·0	80·5	—		
III.		Single		6·6	5·400	147	372	1·30	0·495	16	1:2·62	8·70	11·35	7·0	128	434·5	76·9	83·5	85·0	83·5	79·7	74·5	—		
IV.		Double		10·4	11·26	172	1250	1·30	2 × 0·325	15	1:4·0	11·7	14·2	10·4	160	1250	81·3	85·5	86·5	86·5	85·0	83·5	—		Electrical at Generator
V.	Horizontal Axis, Spiral Wheel-Case	Single	Electrical Central Station	42·6	1·300	428	550	0·80	0·100	15	1:8·0	17·8	28·5	42·0	411	550	81·5	82·0	81·5	80·0	78·0	75·0	70·5	Weir	
VI.				62·0	5·000	400	3200	1·10	0·220	17	1:5·0	23·1	34·8	64·0	400	4000	—	—	—	87·5	86·5	84·5	81·5	Rotating Current Meter	
VII.		Double		60·0	4·000	500	2500	0·90	2 × 0·0975	—	1:9·3	23·4	34·2	60·0	496	2696	78·6	87·5	87·5	84·5	78·0	—	—		
VIII.				87·0	2·875	500	2500	0·95	2 × 0·110	19	1:8·6	25·0	41·2	87·0	490	2620	83·5	85·5	84·5	83·0	80·5	77·7	—	Weir	
IX.				143·0	2·000	600	3000	1·10	2 × 0·0400	—	1:27·5	34·2	52·8	147·0	601	3458	77·2	79·5	78·5	77·0	74·5	71·8	—		

TABLE 3—DIMENSIONS AND TEST RESULTS OF FRANCIS TURBINES.

nature of section, the difference between the two sets of measurements is to be regarded as small, except in the case of the last.

Another example of the comparison of simultaneous measurements is to be found in an article by the author entitled "Comparative Investigations on Reaction Low-Pressure Turbines" in the Swiss "Bauzeitung," 1905.

C.—Measurement of Effective Horse-Power.

In four tests, a Prony brake was used, and throughout, a wood lining to one half of the peripheral band, brake-cheeks round the other, with worm tightening gear, and external force applied, so as to cause compressive stress in the band. In the other tests, the effective horse-power of the turbine was transmitted to the generator (dynamo), and there measured electrically, due allowance being made for the previously measured mechanical and electrical efficiency of the generator. The electrical measurements were carried out by special electrical experts, with the help of suitable arrangements and instruments.

D.—Measurements of Revolutions Per Minute.

This was effected by mechanical hand tachometer, with minute intervals, and often by direct counting with acoustic signals of time intervals.

E.—Registration of Speed Variation With Change of Load.

For this, there was used the Horn tachograph.

F.—Measurement of Pressure Variation With Change of Load.

This was obtained by means of the instruments above mentioned, for measurement of the falls. Throughout the course of each test, the observations were made as far as possible simultaneously, but at the same time independently.

G.—The Results of the Tests.

The results of the tests I to IX inclusive of Francis turbines are collected in Diagrams I to V inclusive. Those of the tests Nos. X to XIII inclusive are similarly represented in Diagrams VI and VII.

H.—Results with Francis Turbines.

(a) Open Arrangement.—Tables 1, 3, 4. From Table 1 it is seen that:—

(1)—In turbine I, the maximum efficiency is reached at nearly full load; but in the other turbines it is found at between 70 and 80 per cent. of full load.

(2)—All four turbines have an efficiency of over 85 per cent. at about 80 per cent. of full load.

(3)—Turbine IV maintains greater uniformity of efficiency than the other turbines do

(4)—The simple turbines II and III have similar efficiency curves, that of III showing throughout, smaller efficiency than II.

(5)—Turbine II has a second maximum efficiency at about 30 per cent. of full load.

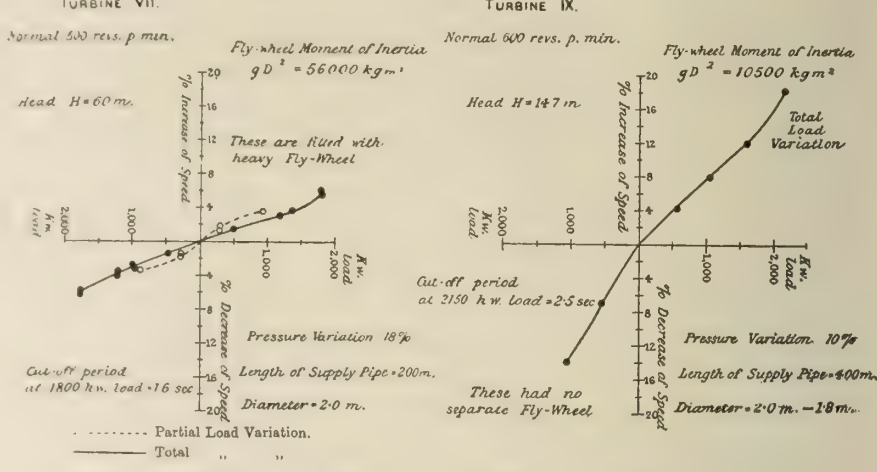

TURBINE VII.
Normal 500 revs. p. min.
Fly-wheel Moment of Inertia
$gD^2 = 56000$ kgm²
Head H = 60 m.
These are fitted with heavy Fly-Wheel
% Increase of Speed
% Decrease of Speed
Kw. load
Pressure Variation 18%
Cut-off period at 1800 kw. load = 1·6 sec
Length of Supply Pipe = 200 m.
Diameter = 2·0 m.
Partial Load Variation.
Total ,, ,,
TURBINE IX.
Normal 600 revs. p. min.
Fly-wheel Moment of Inertia
$gD^2 = 10500$ kgm²
Head H = 147 m.
Total Load Variation
Cut-off period at 2150 kw. load = 2·5 sec
Pressure Variation 10%
Length of Supply Pipe = 400 m.
These had no separate Fly-Wheel
Diameter = 2·0 m. – 1·8 m.

TABLE 5—RESULTS OF TESTS OF GOVERNING TURBINES VII AND IX.

The diagrams show the maximum change of speed with sudden charge or discharge. Observations to the left of each vertical line represent charge in Kw.; those to the right discharge in Kw.

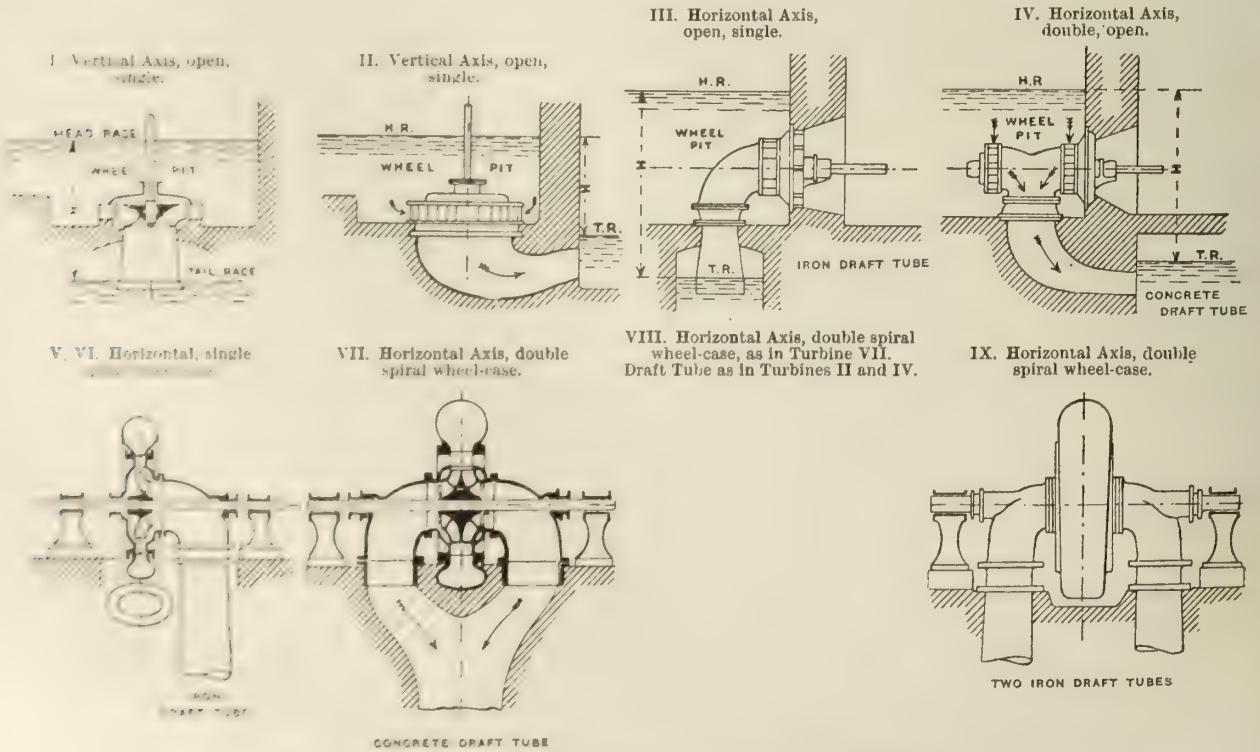


TABLE 4—SKETCH CLASSIFICATION OF FRANCIS TURBINES I—IX.

On Table 3, the data of the designs are given, specifying the size of turbine and its rotary speed; that is, the values on which are based the calculations of the fall, the water consumption, the revolutions per minute, and the desired efficiency; also the wheel diameter D, the inlet breadth of wheel B, the ratio B /D, the peripheral speed u=pi. Dn /60 the theoretical speed $c = \sqrt{2gH}$, corresponding to the fall H, and finally the ratio Ku = u /c, which is the characteristic speed-coefficient of the turbine. Along the heading of Table 3, are also given the efficiencies taken from Tables 1 and 2.

It is seen from this table that the wheel diameters of turbines I to IV are nearly equal; but the ratios of width to diameter B /D and also the speed-coefficients Ku are nevertheless different. In respect of this last co-efficient, turbine I is to be classed as "normal dimensioned normal speed"; turbine IV as "normal dimensioned high speed"; turbine II as "extra width normal speeed"; and turbine III as "extra width high speed." In consequence of the equality of the diameters in turbines I and IV, the results from them are directly comparable, and the comparison yields the following important conclusions:—In open low-pressure Francis turbines, it is possible, even with extra width high-speed machines, to reach a maximum effective efficiency of 85 per cent. with an opening of the Fink rotary regulation gates corresponding to about 80 per cent. of full load; while with normal speed and divided inlet passages, having axially moved gates, still higher maximum efficiencies, up to 88 per cent. are attainable.

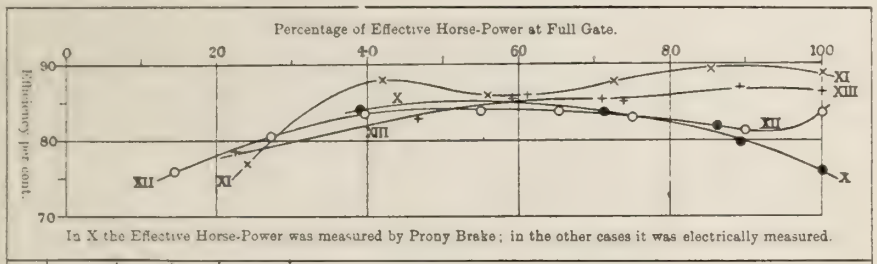
The appearance of a second efficiency-maximum in turbine II, appears at first difficult of explanation; the cause, however, is masked by influences arising in connection with no-load running, on varied gate-opening, and the phenomenon proves that in such wheels, different stream-line forms may occur,—a phenomenon also observed in centrifugal pumps.

In the upper row of figures on Table 4, the classes of the designs of turbine I to IV are sketched.

(b) Arrangement with Closed Spiral Wheel Cases.—The results of the tests of turbines V to IX are set out on the tables 2, 3, and 4, along with the important dimensions of the same arranged in tabular and graphic forms. In the lower row of figures on table 4, their general arrangement and class of design is sketched. From the diagrams on table 2, it may be seen that also in this arrangement, the maximum efficiency is reached between 80 and 90 per cent. of full load; but the values of the efficiency for the same percentage load, differ for the different turbines of this series, much more than in the previously described series. A direct comparison can be made between the turbines V, VI, VIII, and IX: their efficiency curves having very similar general forms. From the dimension-data given in table 3, it can be recognized that the values of the efficiencies decrease as the ratio of breadth to diameter decreases. This comparison shows clearly the influence of the greater resistance of the channels of smaller flow-surface. Still, the diagrams show here also that in this style of turbine, efficiencies of 85 per cent. and more are attainable.

The form of the efficiency curve of turbine VII differs greatly from those of the other turbines in this series; it is, however, similar to that of turbine III in the previous Series I to IV. It is to be noted, that the correctness of the curve is confirmed by the tests of the governing of the different units of the installation to which turbine VII belongs. The apparent difference is probably caused by the form of the blades; but as drawings of these blade-forms are not presented, it is not possible to form a definite judgment upon this point.

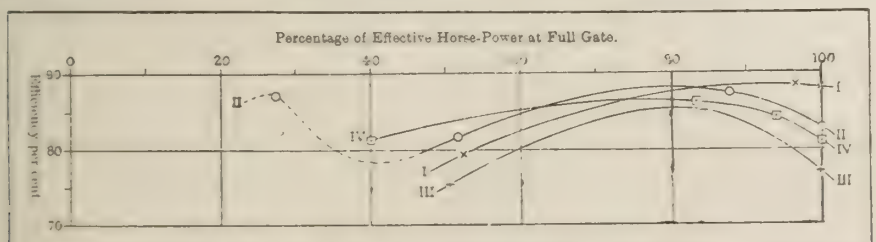
In table 5 are given the results of the tests of the governing of turbines VII and IX. Here it is to be noted, that in the Servo-motors of the automatic speed and pressure regulator, oil is used as the Servo-motor fluid, and each of the two governing plants is worked from an oil-pressure central station, in which the oil can be brought to a pressure of between 20 and 25 atmospheres. Alongside of the diagrams of table 5, are placed those leading dimensions which are necessary for a criticism of the general effectiveness of the regulation, as for example, the fly-wheel mass, the size and length of the supply pipe, etc. It must further be pointed out, that the Servo-Motor of the automatic pressure regulator of turbine VII, is fitted with a governing gear, brought into action under the influence of a rise of pressure in the supply pipe, caused by a sudden decrease of load; while in turbine IX, a similar gov-



In X the Effective Horse-Power was measured by Prony Brake; in the other cases it was electrically measured.

No.	Number of Nozzles.	Fall in Metres	Revs. per Min.	Efficient H.P. at Full Gate.	a = per cent. of Full Load. b = per cent. Efficiency of the Turbine.											
					a	b	a	b	a	b	a	b	a	b	a	b
X.	2	90	355	326	100·0	76·0	89·3	79·7	86·5	81·6	71·4	83·6	39·6	84·2	—	—
XI.	1	100	190	300	100·0	88·9	85·4	89·3	72·7	87·8	56·0	86·0	42·0	87·8	24·0	77·0
XII.	2	350	376	6050	100·0	83·5	89·9	81·0	75·8	82·8	55·1	83·8	27·1	80·5	14·2	75·9
XIII.	1	850	630	3710	100·0	86·2	89·4	86·9	59·2	85·2	71·2	85·1	46·7	82·9	22·3	78·5

TABLE 6—EFFICIENCY OF PELTON WHEELS.



No.	System	Fall in Metres	Revs. per Min.	Effective H.P. at Full Gate.	a = per cent. of Full Load b = per cent. Efficiency of the Turbine.								Measurement of Horse-power.
					a	b	a	b	a	b	a	b	
I	Single vertical axis	4·6	190	158·5	100·0	88·1	96·8	88·6	52·7	79·4	—	—	Mechanically by Prony Brake.
II		4·4	100	262·0	100·0	82·5	88·0	87·8	51·9	81·9	32·7	87·2	
III	Single horizontal axis	7·0	185	434·5	100·0	76·9	84·0	85·1	50·8	75·4	—	—	
IV	Double horizontal axis	10·4	190	1250·0	100·0	81·3	93·8	84·2	78·5	86·3	40·3	81·5	Electrically.

TABLE 1—EFFICIENCY OF FRANCIS TURBINES IN OPEN WHEEL PITS.

erning mechanism is brought into action by a part of the Servo-motor, moved by the automatic speed-regulator, and is again put out of action under the influence of a cataract.

The very much less speed variation in turbine VII is apparent. The fly-wheel moment of inertia is, however, materially greater than that of turbine IX. This circumstance, in conjunction with the quicker action of the Servo-motor on turbine VII, indicated by its cut-off period, is the cause of the smaller vibration in turbine VII. In both cases the re-establishment of steady normal condition is reached in the time necessary for safe working under maximum load variation, following maximum speed regulation.

J.—Tests of High Pressure Turbines.

Pelton Wheels.—On Table 6, are set out in tabular and graphic form the results of tests of four high-pressure turbines, X to XIII, in respect of efficiency: and on Table 7, the results of tests of the regulation of the turbines XII and XIII of this series are stated The wheels of these turbines are fitted with Pelton blades. The forms of the blades certainly differ from the original Pelton shapes, and are constructed as the result of study and experience of individual turbines which have been in practical use. The variation is also partly apparent in the shapes of the efficiency curves. The important conclusions to be drawn from these series are the following:—

(1)—At about 55 per cent. of full load, all the four turbines show efficiencies which lie between 84 and 85 per cent.

(2)—The most favorable efficiencies vary between 84 and 89 per cent.

(3)—The efficiency is lower than 80 per cent., only under loads which are below 25 to 30 per cent of the full load.

(4)—These definite results hold within wide limits of head and load (90 to 850 metres head and 300 to 5050 horse-power); and it is to be noted that confirmatory results are obtained also from tests of other turbines of the same kind.

Regarding the results of the tests of the governing of turbines XII and XIII set out upon Table 7, it may be noted that both these, as also turbines X and XI, are fitted with the well-known nozzles with pointed governing needles These needle-nozzles, due to Abner Doble, regulate the supply of water, according to the momentary demand for power, following small and gradual changes of load, by the movement of the needle which takes place under the influence of an automatic speed regulator.

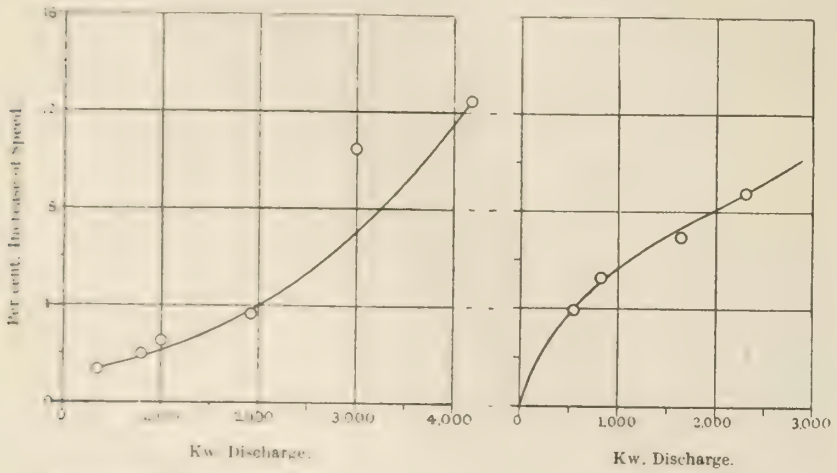
Very important variations of pressure arise in the long supply-pipes which accompany this design of turbine, following sudden changes in load. In order to avoid these, turbine XII is furnished with an automatic-pressure regulator and Servo-motor, similar to that of turbine IX, whose regulating mechanism is put into activity by the Servo-motor of this speed regulator.

In turbine XIII, the automatic pressure-regulation arising through sudden loading, takes place in the following manner. In the first instance following the decrease of load, the jet issuing from the nozzle is deflected by the interposition of a shutter, inserted between the nozzle and the wheel, under the influence of an appropriate automatic regulating mechanism, for the purpose of hindering the access of the water to the wheel; through this, the supply of hydraulic energy to the wheel is diminished. While the flow of water from the supply-pipe is still not decreased, no sudden rise of pressure in the pipe can therefore take place. In the succeeding time-period, the shutter is gradually withdrawn again, and the needle displaced in the nozzle, as necessary for the re-establishment of normal steady condition. The insertion of the needle thus follows so slowly, that no important increase of pressure can arise.

On Table 7, there is stated the important leading dimension-data alongside of the diagrams, in the same manner as on Table 5. The influence of the very large fly-wheel mass in turbine XII makes itself apparent here also, along with the smaller variation in speed. One recognizes, however, through comparison of the two diagrams upon Tables 7 and 5, that the absence of the large fly-wheel mass in turbine XIII is compensated for by the quickness of the governing action, operated by the deflection of the jet. It should be further mentioned, that in all the turbines mentioned here, the test results obtained give better value than those guaranteed by the firms who supplied the plant. The results here set forth confirm satisfactorily the proposition stated at the beginning of this paper, that the design of turbines has almost reached the limit of attainable perfection.

Conclusions.

In regard to efficiency, there is not to be expected that much further tdvance in the future; the problem of governing can still be considered as not yet completely solved, since there still appears in view a series of applications which will influence the further development of this problem. The electrification of railways may be mentioned as one example. One may as well express the hope, considering the experience of the results already reached, that with the help of the material and intellectual instruments now available, technical science will be able to find a satisfactory solution of these future, and perhaps often much more difficult problems.



The test with 3,000 kw. load is questioned.

TABLE 7—RESULTS OF TESTS GOVERNING OF TURBINES XII AND XIII.

Both Turbines are governed by Oil-Pressure Servo-Motor.

Turbine XII	Turbine XIII.
The turbine is fitted with automatic pressure regulation.	The Turbine is fitted with jet cut-off gear.
Normal 375 revs. per min.	Normal 630 revs. per min.
Head H equal 350 m.	Head H equal 350 m.
Max. Pressure Variation 1·9 per cent.	Max. pressure variation 3·9 per cent.
Length of supply pipe equal 925 m.	Length of supply pipe equal 2130 m.
Diameter equal [illegible] m. — 1·05 m.	Diameter equal 0·5 m.

Practical Advantages in the Use of Superheated Steam*

By H. G. Bertram, B.Sc.

Showing That Piston and Valve Leakage is Very Much Reduced When Superheated Steam is Used in Preference to Saturated Steam. The Writer Discusses the Question in Simple and Easily Intelligible Language, Requiring but Little Application and Study on the Part of Our Readers to Grasp the Situation.

THE principal losses in the steam cylinder have been attributed to two causes:—

(a) Condensation due to the hot steam striking the cool walls.

(b) Leakage past the piston during stroke.

The former of these was discussed in our July Number, and the latter is that to which the present refers particularly.

Loss From Piston and Valve Leakage.

The theory, that cylinder loss is to a great extent due to leakage, has been championed by many writers, therefore, it will be well to show why superheating does improve the cylinder action in this respect. As in the last example, we will take steam at 115 lbs. pressure per sq. inch, or 16,550 lbs. per square foot, and consider three cases.

1. Dry saturated steam.
2. Steam 95 per cent. dry.
3. Steam superheated 200 degs. Fah.

The velocity of flow of steam from one point to another, is proportional to the square root of the head or $V = \sqrt{2gH}$

Let W = weight of 1 cubic foot of steam at the given pressure.

H=head equivalent to the boiler pressure.

P=corresponding pressure in lbs. per sq. ft. = WH lbs.; therefore

$$H = \frac{P}{W} \text{ and } V = \sqrt{2g\frac{P}{W}}$$

Case I.

From the steam tables, 1 pound of dry steam at 115 lbs. pressure weighs .2628 lbs., therefore the head to force the steam through a space or opening would be

$$H = \frac{P}{W} = \frac{16550}{.2628} = 63000 \text{ ft., and the velocity of flow} = V = \sqrt{2gH} = \sqrt{2g \times 63{,}000} = 2{,}008 \text{ ft. per second.}$$

Case II

In this case we must find the weight of the mixture of steam and water per cubic foot.

.95 lbs. of steam at 115 lbs. abs. occupies 3.58 cu. ft. .05 lbs. of water occupies .009 cu. ft. 1 pound of mixture occupies 3.589 cu. ft. Therefore 1 cubic foot weighs

$$\frac{1}{3.589} = .278 \text{ lbs.}$$

The equivalent head would be

$$\frac{16{,}550}{.278} = 59{,}600 \text{ ft., and the velocity due to it} = 1{,}952 \text{ ft. per second.}$$

Case III.

The weight of 1 cubic ft. of superheated steam at (338 + 200) = 538 degrees Fah. 1 lb. of saturated steam at 338 degs. occupies 3.8 cu. ft., and assuming it to expand like a perfect gas we have for its volume

$$3.8 \times \frac{461 + 538}{461 + 338} = 4.75 \text{ cubic feet;}$$

therefore 1 cubic foot weighs $\frac{1}{4.75} = .21$ lbs., and the head equivalent would be

$$\frac{16550}{.21} = 78{,}900 \text{ ft. The velocity due to this head} = 2{,}244 \text{ ft. per second.}$$

The weight of a fluid discharged through an orifice is proportional to its velocity, and to 1 cubic foot weight. If we multiply the velocities by the weights per cubic foot, for the three cases, we get the products to which the leakage is proportional, as follows:— Saturated steam = 2008 × .2628 = 525. Steam 95 per cent. dry = 1952 × .278 = 543. Steam superheated 200 degs. = 2,244 × .21 = 471.

The wet steam it will be noted, increased the leakage by

$$\frac{543 - 525}{525} \times 100 = 3.4 \text{ per cent., and}$$

the superheated steam reduced it by

$$\frac{525 - 471}{525} \times 100 = 10.3 \text{ per cent.}$$

As explained previously, these examples are purely theoretical, and the actual saving to be derived, will be considered under "Economy of Superheat."

Superheaters.

Having considered some of the main reasons why superheated steam should be used we will now turn to the more practical side of the question.

In the use of saturated steam, one of the main objectionable features has been the variation in temperature due to losses, therefore, in making use of superheated steam, it would appear that the first desirable condition should be a constant degree of superheat. In practice up to the present time, this is far from being realized, and the reason lies, no doubt, in the fact that manufacturers are unwilling to change their standard designs of boilers and settings, in order to place the superheater to the best advantage, preferring to adapt it to existing conditions and make the best of the results. There is no doubt that it means considerable expense, and increases the first cost to the buyer, but initial cost is rarely considered in a large plant, where steadiness and few stops for repairs are the main requisities.

In installing a superheater it is not sufficient to insert the tubes in the hottest hart of the boiler setting, for although this ensures superheated steam, it falls far short of the original aim,— to have a constant temperature. In a hand-fired furnace attended by an average fireman, the variation in the temperature of the gases, due to adding green fuel, poking the fire, varying the draft, or an excess of ash and clinker will affect the heat output to a very marked degree. Automatic firing and a steady draft will partly overcome this, and limit the maximum variation to about 30 per cent. in the degree of superheat at the outlet pipe. In such a case a superheater giving an average of 100 degs. superheat would vary between 136 and 184 degs.

Separately fired superheaters are used in some places, but they also are subject to the unfavorable conditions of the ordinary boiler, due to fuel, draft and handling. The added first cost and additional fuel required, make this proposition seem somewhat unfavorable. An ideal form, however, would be a separately fired superheater using gas as a fuel, but since this is only to be obtained for such purposes near a large steel plant or blast furnaces, it need not be considered, and our attention must be turned to the improvement of the present types.

Superheater Location.

A superheater will only produce steam of a given degree superheat, when it is so placed that with a constant pressure and unvarying supply of steam on the

*Fourth article of a series. The fifth paper will deal with the location of the superheater, its surface area, material and expansion provisions.

inside, its outside is subject to a fixed quantity of hot gases at a constant temperature. To accomplish this, it has been recommended that the superheater elements be protected by a fire brick arch or covering, and the desired quantity of hot gases be by-passed to it from the furnace. The effect of the brick, would be to neutralize any variation in furnace temperature, and keep the superheat more nearly constant, with a battery of boilers emitting steam into a common header. With this provision, the average temperature should show an extremely small variation.

Control and Regulation.

In ordinary work, the control or regulation of superheat has been accomplished in different ways.

1.—Injecting cold water into the superheater elements. This is open to the objection that the water carries impurities into the pipes, which will in time become filled up.

2.—By-passing the flue gases, or placing dampers in the flues. This is irrational, because the least draught is to be had where most is needed.

3.—Admitting cold air into the superheater; method necessarily wasteful.

4.—Superheaters reinforced by masses of cast iron to store up heat. Objected to because of its being too costly.

5.—Hot water circulation through pipes located inside of superheater elements. A method which is much too complicated.

6.—Mixing superheated steam with saturated steam automatically in a comingler.

7.—Returing excess heat of superheated steam into boiler, thereby not only increasing the evaporating capacity, but improving water circulation.

The last two methods are rational and economical, and can be automatically arranged.

Place and Value of Low Pressure Turbines

By J. G. Callan

The Great Energy Efficiency of the Low-pressure Turbine, and a General Summary of the Conditions of its Profitable Use are Briefly Presented in the Following Extract From a Paper by J. G. Callan, of Arthur D. Little, Inc., Chemists and Engineers, of Boston.

NEGLECTING small corrections, the energy developed by expanding a pound of steam is determined solely by the ratio of expansion. Hence, expansion from 1 pound to ½ pound absolute, (28 inches to 29 inches vacuum) should develop as much energy as expansion from 200 pounds to 100 pounds, and expansion from atmospheric pressure to good vacuum, as much energy as that from ordinary boiler to atmosphere.

The reciprocating engine is well fitted to deal with the small volumes of dense, high pressure steam found in the early stages of expansion, but hopelessly ill-adapted to the huge volumes of highly attenuated steam, found in the expansion stages of lowest pressure. Turbines show particularly good efficiency in dealing with this low pressure steam, since there is little trouble in handling the large volumes, and because most of the important turbine losses are minimised by reduction of pressure.

The combination of an engine for high pressure ranges, and an exhaust steam turbine for low, shows materially better economy than can by any possibility be obtained from the former, alone, and gives nearly its maximum economy over a much wider range of loads than does any efficient form of engine. In an engine which is enefficient through low expansion ratio, the combination will be highly satisfactory, and should leakage, bad steam distribution, excessive condensation or the like, be the trouble, the combined efficiency will be somewhat less, although usually still quite an improvement.

With the engine highly efficient, high vacuum available, and turbine and engine both feeding the same bus bars, the combined unit gives a higher thermal efficiency and delivers more power per pound of steam than has thus far been obtained by any other means. This efficiency is well maintained with variable or fluctuating loads, the combination partaking in this respect, of the character of the turbine. Under such load conditions and with good boiler efficiency, the full economy is perfectly comparable with that of good gas engines under like conditions. It would seem, therefore, that the low pressure turbine has a good field, and one naturally looks about for the reason preventing its wider adoption. We venture the opinion, that outside of commendable conservation, upon which is piled no little, and less commendable inertia and apathy, no other reason will be found, and that the future will see the low, and particularly the mixed pressure turbine take its place as one of the accepted and important instrumentalities of efficient power generation.

CANADIAN BOVING CO. STAFF ADDITION.

Owing to the continual expansion of the business of the Canadian Boving Co., necessitating the frequent absence of their manager, F. A. Yerbury,, from the Head Office in Toronto, for considerable periods, the English Parent Co., have entered into arrangement with Aubrey V. Clayton, M.I.E.E., to temporarily take charge. During his stay here, Mr. Clayton will also look into the possibilities of establishing works in this country for the manufacture of some of the Canadian Boving Co.'s varied specialties, which include turbines, pumps, and pulp-making machinery. Mr. Clayton's qualifications in this respect are unrivalled, owing to the unique experience he has had of English, American and European methods. His ten years' pioneering experience in Scandinavia, where he was partly responsible for the starting of the Magnet Co., and entirely responsible for the inauguration of the Clayton-Unger Works, the amalgamation of which interests now operate with a capital of about one million dollars, should be of great asistance to him here. The chief manufactured products of Scandinavia, timber and pulp, are similar to those of Canada, and it has been in connection with machinery for the manufacture of these, and the equipment of hydraulic power with electric transmission, that Mr. Clayton has been chiefly employed.

INVENTION BY AN I. C. R. ENGINEER.

J. D. McKay, 448 Main Street, St. John, N.B., has invented a "Coal Economizer and Smoke Raiser" for Locomotives and Steamships. It is claimed to be simple, efficient and readily adapted to any smoke stack. Patents have already been obtained in Canada and the United States, while those for leading European countries are pending.

FOWLER'S MECHANICAL ENGINEERS' POCKET BOOK.

H. Howard, Welland, Ont., can obtain Fowler's Mechanical Engineers' Pocket Book by communicating with the Scientific Publishing Co., Manchester, England.

W. Fitzgerald Kelly, the Ontario representative of the Canadian Tungsten Lamp Co., is back on his own ground again. He has been absent for the last two months, looking after the Montreal Branch. Mr. Grose, the Montreal Manager, has now fully recovered from his lengthened sickness, and this has enabled Mr. Kelly to return home.

Steam Boiler Construction and Upkeep Considerations

By H. S. Jeffery

A Discussion of General Constructional Details, the Rules and Practice Relating to Same, and Their Effect on the Safety, Efficiency and Life of Any Type of Steam Boiler.

THE factor of safety of a boiler shell is one of the many subjects in the boilermaking field on which general agreement has not been reached, and its range is from 2½ to 6.

Boiler Explosions.

The Hartford Steam Boiler Inspection and Insurance Co., in the January 1908 issue of their publication, the Locomotive, gave a tabulated statement of the total number of boiler explosions, from 1879 to 1907, inclusive, brought to their notice. The total was 8,512.

The causes of boiler explosions and disasters, given by the committee of the Master Steam Boiler Makers' Associationtion at their 1908 convention, Detroit, Michigan, are as follows:

1. Defective design, resulting in weakness of parts; defective circulation; faulty arrangement of braces and matters over which the designer has control.

2. Poor construction, including defective material; faulty workmanship; omission of braces, stays, etc.

3. Decay of structure with age, or in consequence of lack of care in its preservation; local defects due to some such cause, as an unobserved leakage that produces deterioration.

4. Management in operation, giving rise to excessive pressure, low water, the sudden throwing of feed water on over-heated plates, or the production of other dangerous conditions; failure to make sufficiently frequent inspection and test, and thus keep watch of defects which grow dangerous with time.

The Board of Trade (England), considers that boilers well constructed, well designed, and made of good material should have an advantage in the matter of working pressure over boilers inferior in any of the above respects. Therefore, for the boiler shell, they have a graded factor of safety, adding certain penalties in each instance, where good workmanship, design, and materials is not in evidence.

Punched and Drilled Holes.

Rivet holes for the connecting of the boiler parts are either drilled or punched. Punching rivet holes with a spiral or flat punch, injures the plates, and the more so, if the edges of the punch or die, or both, are rounded off by wear. The plate, suspended as properly as practicable, is rarely at right angles to the punch, with the result that injury is more liable at one point than at another. The diameter of the die is greater than the diameter of the punch at its cutting edge, and the holes when punched are not of uniform diameter their entire depth; in fact, the diameter of the hole on one side of the sheet is liable to be one-sixteenth of an inch larger than the diameter on the opposite side. The holes are not taper, that is, a gradual taper, for the punching of the plates causes the holes with light plates to be as shown in Fig. 43, and with heavy plates as shown in Fig. 44.

Many boiler manufacturers ream the holes one-sixteenth of an inch, their idea being to get them to match. No matter how accurately the boiler is laid out, the rivet holes will not match as will rivet holes drilled in place. The intent and purpose of reaming is not only to make them match, however, the first and foremost object being to remove that part of the plate around the hole, which has fine fractures and is otherwise injured by the punching. As to the amount to be removed, a good general rule is to punch the rivet holes one-fourth inch under size and ream out in place.

Factor of Safety.

It is generally acknowledged that boilers, with rivet holes drilled in place, should be allowed a lower factor of safety than those in which the rivet holes are punched, even though they be punched small and reamed out, as outlined above. This has led to the adoption of a minimum factor of safety for the boiler shell, and the adding of certain amounts in the form of penalties, for the least departure from good design and workmanship or both.

FIG. 43.

FIG. 44.

The minimum factor of safety with good materials, design, workmanship, with butt joint having inside and outside welt straps, and rivet holes drilled in place, should not be less that 4. A boiler of like construction, except that holes are drilled small and reamed in place, should not be allowed a factor of safety of less than 4½, and boilers with lap joint construction (a type of longitudinal seam which should not be allowed for high pressure boilers, the factor of safety should not be less than 5.

For the latter the factor of safety should be preferably more, the exact amount being determined after a full examination of the boiler. In short, the factor of safety in the past, with not only the boiler shell but other parts of the boiler, has been entirely too low.

Stress Upon Stay Bolts.

For some time past, reputable insurance companies have advocated a greater factor of safety for various parts of the boiler, among these being a stress of 6,000 pounds per square inch sectional area of staybolts. However, while this value might be adopted for all boilers, it is nevertheless true, that some types of boiler are subjected to harder usage than others. This is especially true of the locomotive boiler.

It is hardly necessary to set forth the reasons, because those familiar with the respective types of boilers and the service to which they are put, are aware that the locomotive boiler is out in all kinds of weather, day and night, hauling large and heavy trains over hills and grades, and around curves. They are forced to their utmost capacity, while the average boiler of other types is not so forced, and as a rule not only receives better attention, but the service to which it is put is more uniform than that imposed upon locomotive boilers. This fact causes many boiler designers to allow staybolts installed in locomotive boilers a stress of 6,000 pounds per square inch sectional area, and with stationary and some other types, a stress of 7,500 pounds.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

VALVES AND VALVE GEARS—I.

By F. H. Chesher*

THE valve gear of an engine may be defined as that part of the mechanism, which controls the distribution of steam to the cylinder.

Valve gears are classified in a variety of ways, depending partly on their type, and partly on the service for which they are to be used. The most common terms used to denote the different types and classes of service are as follows:

Valve Gear Types.

Fixed cut-off gears.—In this type the motion of the valve does not vary with the amount of work done in the cylinder. For a given setting of the valve, cut-off is constant. A plain slide valve engine is the most familiar example of a fixed cut-off gear, because with it, the points of admission, cut-off, release and compression do not vary.

Variable cut-off gears.—Under this head, are included all those gears, through which the amount of work done in the cylinder can be regulated while the engine is in operation, by varying the motion of the valve, and changing the point of cut-off. If the motion of the valve is controlled automatically by some form of governor, a variable cut-off gear becomes an automatic cut-off gear.

Positive motion gears are those, through which the valve is directly controlled by the eccentric and governing mechanism, during its whole range of operation, while cam gears impart motion to the valves by means of cams, instead of eccentrics. These latter are much used in conjunction with poppet valves.

Releasing or trip gears, as they are sometimes called, vary the point of cut-off by releasing the admission valve from the control of the eccentric, and thus permit it to be quickly closed by some other device, usually a spring or dashpot. The Corliss valve gear is the most familiar example of this type.

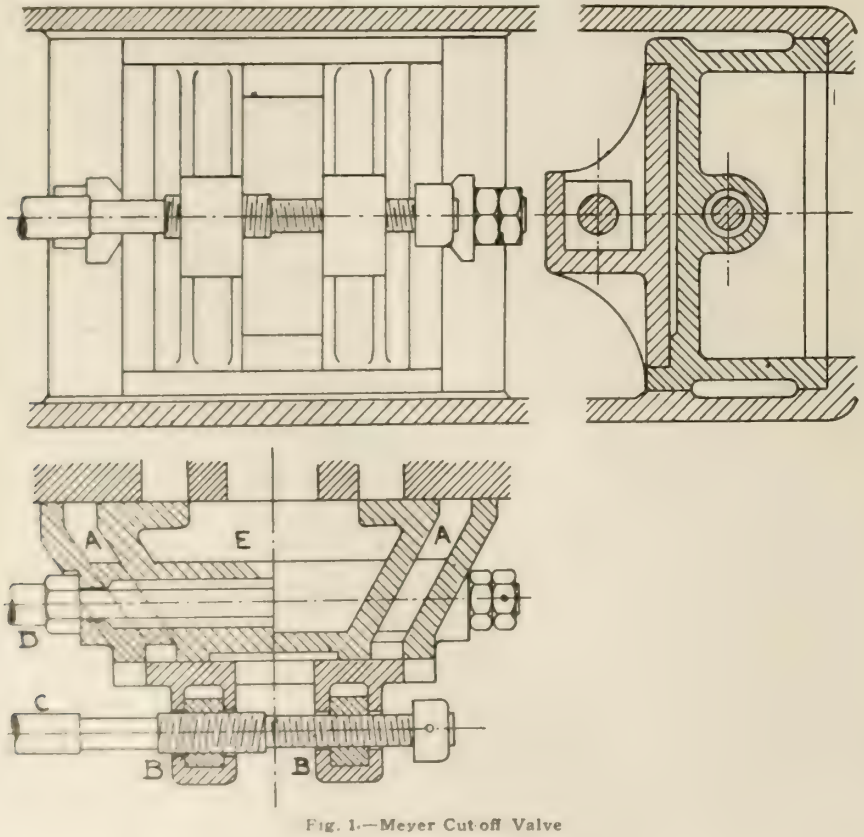


Fig. 1.—Meyer Cut-off Valve

Number and Type of Valves.

The classification may be further extended, so as to cover the number and type of valve used to control the steam distribution.

In accordance with the former, the leading divisions are single, double and four valve, while in the latter, the leading types are slide, rotary, poppet, and cut-off or expansion valves. To extend the range of cut-off beyond that obtainable with the plain slide valve driven with a fixed eccentric, and at the same time not effect the events of admission, release and compression, various types of auxiliary valves, generally known as expansion valves, or cut-off valves have been designed for use in conjunction with the plain slide valve. These auxiliary valves are generally driven by a separate eccentric; their sole purpose being to stop the flow of steam to the cylinder at the desired point of the piston stroke, leaving the other features of steam distribution to be controlled by the main valve in the usual way.

Since the point of cut-off is the only event controlled by the auxiliary valve, any change in its proportions, or in the position of its eccentric that will secure the desired alteration in cut-off, may be made without affecting anything else. The auxiliary valve cut-off may be varied in any convenient way; for example: The valve lap, angle of advance or eccentricity of the auxiliary eccentric may be changed as required.

The Meyer Cut-off Valve.

The Meyer cut-off valve, Fig. I. is an improvement on some of the older types and is free from most of their disadvantages. The main valve consists of a flat plate with a chamber E on its under side. It acts in the same manner as a plain slide valve, from which it only differs, in that its ends are extended to form passages or ports A.A., leading to the edges that control the admission of steam to the cylinder.

The cut-off valve consists of two plates, B.B., which slide on the top of the main valve, so as to close the passages A.A. at the cut-off point desired. The main valve is driven from its eccentric by the valve stem D and the cut-off valve from a separate eccentric by the valve stem C. The main eccentric is set as for the plain slide valve, and the auxiliary eccentric in such manner that when cut-off takes place, its valve has a motion opposite in direction to that of the main valve, closing the passage A, through which steam is being admitted to the cylinder.

Riding Cut-off Valve.

A form of riding cut-off valve, and rather simpler than the Meyer type, is

*Engineer, The Steel Co. of Canada, Ltd.,

sometimes used. In this. the cut-off valve consists of a single plate, the outside edges of which close the passages through the main valve, in the same manner as the edges of the two plates of the Meyer valve. Since the distance between the outer edges of this cut-off valve is constant, the point of cut-off can be changed only by a change in the eccentric, the usual method being to vary the angle of advance.

Riding Cut-off Valve Setting.

In setting the riding cut-off valve, the first step taken is to see that the main valve is properly set, by trying the lead at both ends and adjusting if necessary. The cut-off valve should then be adjusted, so that it will travel equal distances on each side of its central position, with reference to its seat on the back of the main valve.. If the cut-off valve is of the non-adjustable type, set its eccentric in the following manner: Turn the engine to the point at which it is desired to have cut-off take place; then turn the cut-off eccentric until the edge of the cut-off valve just closes the passages of the main valve, which are open to the cylinder, and fasten the eccentric to the shaft.

Meyer Valve Setting.

To set the Meyer valve: Adjust the length of the eccentric rods in like manner as for the non-adjustable type. The screw of the valve stem should then be turned, so as to separate the plates to the greatest distance at which they are designed to be worked. Stops are often provided, to limit the distance between the plates.

To set the eccentric: Turn the engine to the point at which it is desired to have earliest cut-off take place; turn the eccentric on the shaft until the cut-off valve just closes the passages through the main valve, then fasten to the shaft.

Meyer Valve Modification.

A modification of the Meyer valve is shown in Fig. II. This type may be termed an automatic cut-off valve, and is set in the following manner: Adjust the main valve, as with the type already described, and the endwise travel of the cut-off valve, as in the previous case.

The cut-off valve has a rack fastened on its back, and the valve stem has a fast gear, which works in this rack. Outside of the stuffing box, the velve stem is square, and passes through a gear having a square hole in it. The stem of the governor, which is acted upon by the variation of load, has also a rack which acts upon the gear the valve stem works in, causing it (the valve stem) to rotate as well as move endwise by the action of the eccentric.

The lessening of the load causes the governor balls to rise, and at the same time raises the cut-off plate and cuts off steam.

Piston Valves.

The piston valve is one of the lightest and most perfectly balanced types that have yet been devised, and is readily made double-ported. It has, however, several features that have restricted its use to a great extent.

Unless it is provided with some form of packing, there is no means of adjustment to provide for wear, consequently it soon becomes leaky and wastes steam badly. In vertical engines, where the weight of the valve is not supported by the seat, the wear is not so serious, and there are many cases of engines, in which piston valves with no packing except grooves for water to collect, have given the best of service. In horizontal engines the weight of the valve invariably wears the lower part of the seat and destroys its circular form, therefore packing rings of some form must be provided, or leakage will soon become serious.

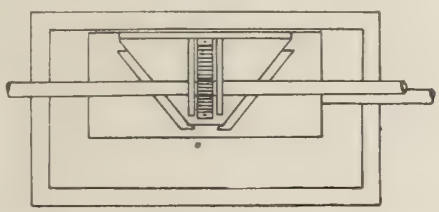


FIG. 2—MODIFICATION OF MEYER VALVE.

In some cases the valve seat consists of a bushing, easily removable when worn, and in order that a good fit between valve and bushing be secured, it is generally necessary to renew the valve as well as the bushing, or fit the old valve and new bushing to each other. The long ports required to surround this type of valve make the clearances large. The piston valve, as generally constructed, offers no relief to water that may be caught in the compression space, after the exhaust port is closed.

Corliss Valves and Gear.

The most striking features of the Corliss gear are four in number. Four semi-rotary valves: Two of these are placed at each end of the cylinder, one (the admission valve) controlling the admission, the other (the exhaust valve) controlling the liberation of the expanded steam. ,

The wrist plate: This is an oscillating disc, plate, or lever, actuated by the eccentric on the main shaft. and in turn communicating motion to the four valves.

The releasing mechanism, of which the governor forms a part, disconnects an admission valve from the wrist plate, when the supply of steam is to be discontinued through its port.

ENGINEERS' LICENSES.

By A. G. Roffey.

SOME engineers contend that licenses are too easily secured. I have travelled from coast to coast, and met scores of so-called engineers, who are able to open a throttle and throw a little oil around, but when a break-down happens they are at a loss, and so immediately send for the machinist.

These men hold certificates, and one naturally asks where this class of man gets his qualification? Well, to my mind, he gets his training by firing in some power plant, or around some threshing outfit for about twelve months. He then considers himself a fit and proper person to become a licensed engineer, and with a little good luck, he gets a provincial certificate. Now, ask yourself if such man can be called an engineer? He is so in name, according to law.

This brings up the question, what is the meaning of the word engineer? I reply, an engineer is a man who thoroughly understands the principles, both theoretical and practical, of steam engines and boilers no matter what their make, and who besides cannot learn all that this description implies in the short space of twelve months. The government ought to make the standard of their examinations so high, that a man has to serve at least five years among machinery, before he can qualify for a 2nd class certificate, and in the case of a 1st class certificate, stipulate that he must spend at least three years in a machine shop. With this kind of training, the status of engineers would be raised, and the man who holds a certificate would be more truly an engineer as I understand the word to mean. When the government issues a certificate one fixed and final payment for it should be made, thus doing away with the present annual purchase system.

ENGINEERS' EXPERIENCES.

By Second Engineer.

I HAVE seen some amusing things during my experience as engineer, and doubtless most of us have. They may have arisen from our own mistakes, in which case they amused others, and when they blundered, we of course were amused. One of the first that I recollect happened some years ago, when I held down the coal shovel.

Experience in Melting Brass.

Our employer came to the engineer one day and asked him if he could melt brass. The reply being in the affirmative, a crucible was obtained, but in-

stead of the engineer being given the job, the factory foreman, who, by the way, was a carpenter, received the honor. He got an old hand forge, and belted it to a small auxiliary engine, built a fire and started operations, with four men helping him. They broke up about twenty valves, all good; used a couple pounds of borax, and in five hours' time had molten metal.

He ran with it to the job, but by the time he got there, the metal had set. He didn't try further, saying that the stuff wouldn't hold its heat, and used zinc instead. As he knew it all and a whole lot more(?) the engineer did not volunteer any information or instruction, but kept the brass as a souvenir. His mistake lay in trying to melt the brass with a fire under the bottom of the crucible, instead of burying the latter in the fire.

Lining-Up.

This same man lined up a pair of bevel gears, (exactly how I cannot say,) but they would not run. The engineer was called in and when he got through, it was found that the centre lines of the shafts did not intersect. It took three men all night to cut away the concrete base sufficient to get these gears in line. After that factory was burned down, and rebuilding started, the foreman contrived to get the best of the work for himself and his men, instead of being content with what he understood, and was capable of. He started to line up the main driving shaft, and had got the boxes bolted in position, when the engineer kicked. This resulted in the latter and his staff getting the job to finish. When we got the line up, we found that every box had been set by its edge, consequently each had to be moved and at least one new hole to drill for it.

Unloading and Installing.

Another most laughable occurrence happened with the same man as principal. A new revolving kiln had been bought, and delivered on two flat cars. It was nearly seventy feet long, and weighed about a thousand pounds per foot. The chief (we had a double watch by this time), was again asked if he could handle the job. Of course he said yes, and indicated what tackle would be required. As before, the factory foreman got the job, and tried it without any additional tackle. He finally got the unloading done, and started to draw the thing into position, with a single chain hitched to it. With half a dozen turns round a shaft, and half a dozen men pulling at timbers stuck through the spokes of six foot pulleys at each end of it, he put steam to a [illegible] engine, which was connected [illegible], and started to haul in. There was full steam on the engine, but not a move. Some of us on seeing the arrangement told the proprietor that something serious might happen if the chain should break, and at his orders the timbers were taken out. Later the chain broke, and before steam could be shut off, the men were scattered. One man found himself perched on the top of a six foot pulley about ten feet from the ground, and wondered how in earth he got there. No personal injuries were received, but a new length of 4½ inch shaft had to replace the other.

Lining Up an Ice Machine.

When working in a cold storage plant in the west two years ago, a new machine was bought, and the erecting engineer actually put it in place without taking the cylinder head off. On suggesting that he put a line through the cylinder, he told me that he didn't believe in it, and could get a truer result by his own method, which consisted of having a man turn the shaft round by hand, while he jacked the cylinder into different positions on the frame until the rod would run through the gland without binding. The machine ran until spring, when it was shut down for an overhaul, as we were unable to keep it from pounding. We centered a line through the guides, because these were in one piece with the frame, to which was bolted the cylinder.. The cylinder was found to be 1-32 inch to one side, pitching down at the front and high at the back end; the crank was nearly ⅛ inch out of parallel with the centre line, in the stroke length; also the piston was somewhat loose on the rod, and the crosshead brasses turned in the crosshead instead of on the pin. Great work for an erecting engineer.

STEAM BOILER REGULATIONS.

By F. W. Hobson, Edmonton.

TAKING advantage of your kind invitation as contained in June number of The Power House, at the conclusion of the article entitled "Variety of Regulations Covering a Vertical Boiler," I would offer the following information to the writer of that article, as also for the benefit of any readers who may be interested in uniform boiler regulations:

(1) The boiler design in question was surveyed, revised and finally approved by the Alberta inspector, under the authorized code of uniform regulations, governing the inspection and construction of boilers.

(2) This code of regulations was authorized by the Canadian Manufacturers' Association in January, 1910, and issued in book form by that body as the result of a conference held at Regina, Sask., in December, 1909. The front cover to this book contains the following notice:

"The regulations herein were agreed on by representatives from the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba and Ontario, and a representative from the Canadian Manufacturers' Association, who met in conference at Regina for the consideration of a uniform measure of this nature in December, 1909.

"These regulations are not in force in any province, and will not be, until issued by the proper officials of such provinces as decide to adopt them. It is hoped that all the provinces will issue such uniform regulations, to become effective during the year 1911."

The Government of the Province of Alberta issued a book of regulations in April, 1909, under which forms were prepared and issued, also a large number of boiler designs approved, but being desirous of uniformity with the other provinces, and in order to assist the manufacturers to obtain this necessary object, they came to an agreement with the authorities of the Province of Saskatchewan to adopt the proposed regulations. The new regulations were issued in Alberta in the spring of 1910, and the reason for such urgency was to prevent further designs being made and submitted under the former rules.

This change caused the province, and those manufacturers who had made their designs conform to the 1909 regulations, considerable extra work and expense, and great care had to be exercised in order to prevent confusion and misunderstanding. New forms had to be arranged, and all manufacturers' designs on record had to be revised to suit the new condition. Over 400 of these have now been officially approved and certified.

The Province of Saskatchewan issued the same uniform regulations in January of this year, and have also approved numerous similar designs; these having received the same consideration and ratings as in Alberta.

Provincial Laxity.

Since so much has been done towards uniformity by these two provinces, all in good faith and with the best endeavor to forward the movement, it would be interesting, Mr. Editor, to know why these important facts are overlooked, and at the same time, quite natural for the two provinces in question to enquire: what are the others doing to assist in the matter of uniformity?

Copies of the uniform regulations can be obtained upon request from the Steam Boiler Branches of the Department of Public Works, Regina, Sask., and Edmonton, Alta.

WASTE GASES OF THE CHIMNEY.*

By W. G. Walters.**

IN dealing with the question of waste gases in the chimney, it may be well for us to take up the subject in detail. Very few engineers operating steam plants, have any extensive knowledge of chemistry, and it is not altogether necessary that they should. They ought, however, to secure a sufficient knowledge of the laws of combustion to enable them to operate their plants with the least possible loss of fuel.

The subjects of smoke abatement and fuel consumption should appeal to every engineer, as they are among the most important questions in the generating of steam power for commercial industries. In discussing these matters in this article we will consider in the first place, coal and its component parts.

Coal and its Combustion.

Coal is a hydro-carbon, consisting of volatile combustible matter, carbon and hydrogen. When completely burned, as it should be, the process involves the combustion of its carbon in the presence of air, and results in the combination of the former with the oxygen of the latter. The carbon is converted into carbon dioxide, CO_2, and depending on the degree of completeness, with which this is carried out, combustion is more or less perfect.

If the operation is not properly carried out, there is incomplete combustion, with smoke and formation of carbon monoxide, CO, due to insufficiency of air. One pound of coal producing CO, only yields about 1-3 of the heat attainable when carbon dioxide is the result. It is obvious then that there is an enormous loss of heat.

A great loss of heat also results if an excess of air is allowed to enter the furnace during combustion, because the excess air absorbs the heat and carries it off to the chimney, instead of allowing water to take it up for steam generation. Air is necessary to support the combustion of hydrocarbon, on account of the oxygen it contains. It is composed of ogygen and nitrogen in the proportion of 21 parts of the former to 79 of the latter. When carbon is burnt to CO_2, the CO_2 forms the same volume in the waste gas, as does the oxygen in the air. When fresh coal is placed on the fire, the volatile gases are at once driven off, absorbing the heat in the process of gasification, and becoming what are known as green gases, susceptible of complete combustion, yielding a return of the heat absorbed, as useful heat.

If they are supplied with the air necessary for complete combustion, the carbon in the coal is converted, it may be to CO, and then with further air to CO_2, or as sometimes happens, to CO_2 instantly.

Let us bear in mind that CO_2, which represents the greatest yield of heat possible from the combustion of carbon, will, if exposed to carbon in a heated state, take up another atom of carbon and be converted back into CO. Should this take place, it is not a building up process, but a reducing one, and instead of yielding heat, the latter is absorbed to a great extent. When the green gases are rapidly and immediately burned to CO_2, heat is evolved in the fore part of the fire before the bridge wall is reached, and as they pass over heated carbon, there is danger of reduction to CO, with absorption of heat and loss of carbon. If, on the other hand, the green gases are not supplied with proper secondary air to effect their combustion, the flame becomes extinguished, and soot is formed and deposited on the boiler plates, making the conduction of heat to the water of little value. The loss of heat through allowing soot to accumulate on the boiler plates, and in the tubes, is much greater than generally believed. It is estimated that an accumulation of soot to the thickness of 1-16 of an inch will mean a loss of conductivity of about 25 per cent.

Boiler Firing.

Fuel should be thrown on or fed to the fire rapidly and evenly, with the draft adjusted by damper regulation, to avoid as much as possible any excessive sudden inrush of cold air due to the opening of the furnace door. When the door is shut, there is required the gradual admission of air with sufficient draught, the former being accomplished by gradually closing the air grids on the doors. The purpose of this air over the fire surface is to complete the combustion of the green gases. Air should then be admitted through the fire right up to the bridge, if possible, so as to pass through the carbon and become warmed, to commence the combustion of the carbon and complete it in the formation of CO_2. This admission of air is effected by adjustment of the ash pit doors. So far as analysis of the flue gases is concerned, the product of the hydrogen in the coal may be neglected.

Results in Actual Practice.

With carbon burned in the presence of air, CO_2 is formed, (or should be), therefore, for every volume of oxygen in the air, a similar volume of CO_2 should be found in the waste gases. Since every 100 parts of air contains 21 parts of oxygen and 79 parts of nitrogen, every 100 parts of the flue gas should contain 21 parts of CO_2. This would be perfectly true if coal were pure carbon, but you will see that consequent on it being otherwise, part of the oxygen is taken up by the hydrogen and part by the impurities in the coal. Therefore, according to the analysis of the coal, so should be the theoretically possible percentage of CO_2 in the flue gas. About 19 per cent. is a possible theoretical figure for bituminous coal, but 15 or 16 per cent. is the highest practical realization.

What you want to bear in mind is, that the lower the percentage of CO_2, the greater the waste in fuel. If coal which might produce, say 15 per cent. CO_2, is burned, and results in only 10 per cent. being obtained, it means that it has been fired and fed with 15-10 or 1.5 times the necessary amount of air. Again, if only 6 per cent of CO_2 is obtained, 15-6 or 2.5 times the necessary amount of air has been admitted. You will, therefore, understand that other conditions being equal, there is a direct proportion between percentage of CO_2 in waste gases and the amount of air passing up the chimney.

Calculation of Waste Gases.

Let us figure out opproximately what the waste will be, by allowing gases to escape to the chimney, with a low percentage of CO_2. We understand that during the process of combustion, these gases acquire a temperature, low or high, and depending to a considerable extent on the boiler setting. Assuming for illustration, that the temperature of the escaping gases is 300 degrees Fahr., and in amount equal to that of the water in the boiler, were we running with steam at 100 lbs. gauge pressure. As it is impossible for us to have a lower waste gas temperature than the absorbing surfaces, we will take this as our basis of figuring. The specific heat of gases with different percentages of CO_2 varies, but for this example, we will assume that it is .33, an amount nearly correct. The heat loss passing up the chimney, of a gas containing 15 per cent of CO_2 will equal $15.24 \times .33 \times 240 = 1207$. The three sets of figures being respectively, the weight of the products, the specific heat of the gas, and the difference between the atmospheric temperature (60) and the heat of the flue gases. Assuming that the coal had a value of 11,450 heat units, therefore

$$\frac{1,207}{11,450}$$

will give us about 10.5 per cent. of the heat in the coal, that we are losing in the chimney. Since 15 per cent. is an almost ideal precentage of CO_2. This 10.5 per cent. must be looked upon as a loss, not preventable, although we should consider how this loss in-

*Paper read before Stratford, No. 31, C.A.S.E.

**Chief Engineer, The Whyte Packing Co., Stratford.

creases, when the waste gases have a lower percentage of CO_2. Below is a table, showing approximate losses, with different percentages of CO_2.

Percentage CO_2										
16	15	14	13	12	11	10	9	8	7	6	5
Percentage Loss in Fuel.										
10	12	13	14	15	16	18	20	23	26	30	35

You will note that 10 or 12 per cent. is unavoidable, owing to impossibility of discharging the flue gases at atmospheric temperature, and as our example takes 300 degrees Fahr., as the temperature of the escaping gases, at a working steam pressure of 100 lbs. gauge, you will admit, that I have figured on what would be an ideal boiler condition, and impossible of attainment in actual practice.

Ideal Conditions Unattainable.

We cannot utilize all the heat of combustion by transferring it to the water, for the reason that the gases from the furnace cannot be reduced lower than the temperature of the steam and water in the boiler, and in addition, a certain amount of heat is necessary above the temperature of the atmosphere to create draft in the chimney, which will induce the required amount of air for combustion, to enter the furnace through the burning fuel. It is possible, however, by proper proportions of grate surfaces and chimney areas, to reduce the temperature of the chimney gases to a minimum, and this in actual practice is about 400 deg. Fahr. Taking 400 degs. Fahr. as our temperature, we would get a still larger percentage of fuel loss than the 10 or 12 per cent. already figured.

It is not to be assumed, putting an a thermometer in the stack, and finding a low temperature, that you are getting economical results, for even if the temperature be 300 degs. Fahr., and you are only getting 5 per cent. of CO_2, there is still tremendous loss; besides your low stack temperature may be due to leaky boiler setting or to excess of cold air being allowed into the furnace, when charging the fires.

In conclusion, bear in mind these notes, that unless you get a high percentage of CO_2, you are wasting fuel and heat, and that the admission of either too much or too little air will reduce your percentage of CO_2, causing smoke, and requiring more fuel to keep up the necessary amount of steam.

WOODEN BOILERS?

By P. D. Q., Montreal.

A RECENT issue of the "Toronto Globe" contained a spicy account of [illegible] on the machinery of [illegible] on a recent voyage to Whitby, Oshawa and Bowmanville. That it was a voyage of discovery, [illegible] amply show.

Secrets are hard to keep now-a-days, thanks largely to intrepid journalism, and in case many of my fellow-readers of your much appreciated paper, The Power House, have not had the opportunity of learning the momentous facts, and knowing that you, Mr. Editor, must feel somewhat confused at being forestalled by a newspaper daily, and therefore believe silence to be good policy, I am helping you out by taking the initiative. The narrative runs thus:

"Sharp at 5 o'clock the Argyle left the city with a large number of passengers aboard and a good cargo of freight, but hardly had they got a thousand feet from the wharf when Chief Engineer McWilliams saw that something was wrong, and on investigation found that 'the pin' had been knocked out from one of the valves.

"The pin was immediately put in place in the valve again and it was thought it would stay in place. Instead it came out several times before the vessel reached the eastern channel.

"When the Argyle reached the lake, a stiff gale was encountered, and Capt. Van Vlack, fearing serious consequences, blew the whistle for assistance to the tug Reid, which was anchored in the lake near the mouth of the eastern channel. The passengers in the meantime were assured that nothing serious was the the matter. The tug immediately responded to the Argyle's distress signals, and when the steamer had been turned around, started for the city with the Argyle in tow, soon after arriving at the company's wharf at the foot of Yonge street

"The Argyle is equipped with two wooden and two steel boilers. The wooden boilers, which are the easiest on the rest of the machinery, had been right through the season up to yesterday. Yesterday morning, however, the steel boilers, which cause much strain on the machinery, were installed, and this was the cause of all the trouble. When the Argyle started out, the greater vibration of these proved too much of a strain on the rest of the machinery, the trouble being made more apparent, owing to a wooden patch with which one of them has been repaired.

"It was the added vibration of these that jarred the valve pin out of place, and thus cutting the steam off, causing the machinery to stop, and the side wheels to come to a standstill. Had the steamer been kept going with the valve pin out of place, the piston rods would have knocked in among the cylinders, and very serious consequences would have resulted. As soon as the passengers were landed, the six members of the engineering department of twelve, who were on duty, were at once put to the work of replacing the steel boilers with the wooden boilers.

"Before morning, they expect to have made the change, and with a new valve pin replacing the one that was shaken out, the machinery will be in good working order again. With the wooden boilers in place, it is stated that the machinery works in first-class shape, and no further trouble is looked forward to. The company announced last night that if the repairs were not more extensive than they then appeared to be, the Argyle would be ready to leave at 7.30 this morning on her regular Wednesday run to Grimsby Beach."

These are the facts as recorded, and in pondering over them it has surprised me that the "belt did not come off the boilers" as well, under such excessive vibration circumstances. We in Montreal always think of Toronto as somewhat of a slow and sleepy community, but have to admit that its journalism and engineering progress have got ahead of us this time.

Societies and Personal

Lodge 25, C.A.S.E., Owen Sound.

At the meeting held on Thursday, 27th July, there was as usual a good attendance. One new member has been added to the roll on each of the last three meeting nights, and several applications are pending. We are making arrangements to take part in the Labor Day procession, and are inviting all engineers whether belonging to our lodge or not, to participate with us, and get an opportunity of seeing what we are doing in the educational interests of our craft.

Lodge 7, C.A.S.E., Guelph.

The annual installation of officers of the Canadian Association of Stationary Engineers, No. 7, was held in their lodge rooms on Friday evening, July 14. J. J. Heeg installed the following officers: Bro. C. B. Angell, I.P.P. ; Bro. R. Dyson, president ; Bro. Jas. Gass, vice-president ; Bro. G. Swift, recording secretary ; Bro. W. Bishop, financial secretary ; Bro. R. Postal, treasurer ; Bro. H. Lodge, con. ; Bro. A. Keating, doorkeeper ; Bros. T. Buck and W. Murray, trustees ; C. B. Angell was chosen as delegate to represent them at the convention in Stratford from 25th to 27th of July.

F. W. Hollingsworth is at present in Vancouver looking after the many and varied interests of the Canadian Tungsten Lamp Co. He reports an exceptionally successful trip, and states that he sees nothing of any depression such as he understood he might expect from reports heard in the east.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

NEW TYPES OF SWITCHBOARD METRES.

THE increasing size of modern power developments, and the growing scarcity of available space, particularly in large cities, have emphasized the need of compactness in switchboard design. The desirability of having all the meters in plain view of one operator has long been appreciated, and this requirement necessitates meters that shall occupy a minimum of space, and at the same time be easily readable from a distance. In many plants in congested districts, the switchboard is located in a poorly lighted place, which imposes the further requirement that the meter dials be capable of thorough illumination. Accuracy and the possibility of making repairs quickly and easily on the premises, are features that every power plant manager requires.

Descriptive Details.

In line with these strongly defined tendencies in switchboard design, the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has developed a design of alternating-current and direct-current switchboard instruments, which, for their novel features, are of extreme interest. The new meters comprise a complete line of seven-inch meters, and a complete line of nine-inch meters. The seven-inch alternating-current meters, known as the type SM, and the nine-inch, known as type TM, are built as ammeters, voltmeters, wattmeters, power factor meters, frequency meters and synchroscopes. The corresponding types SL and TL direct-current meters are built as ammeters and voltmeters. The completeness of these lines make it possible to design an entire switchboard with one uniform type of meter, either seven-inch or nine inch throughout.

The scales of both sizes of alternating-current meters are 14½ inches long. This remarkable scale length is as great as that found usually only in large illuminated dial meters, and greater than that obtainable with edgewise meters that occupy as much room on the switchboard as do these seven-inch meters. The economy of space in comparison with the length of scale, is shown in the following tabulation :—

7-inch type SM covers a rectangle 55 sq. in. ; scale 14½ in. long.

9-inch type TM covers a rectangle 107 sq. in. ; scale 14½ in. long.

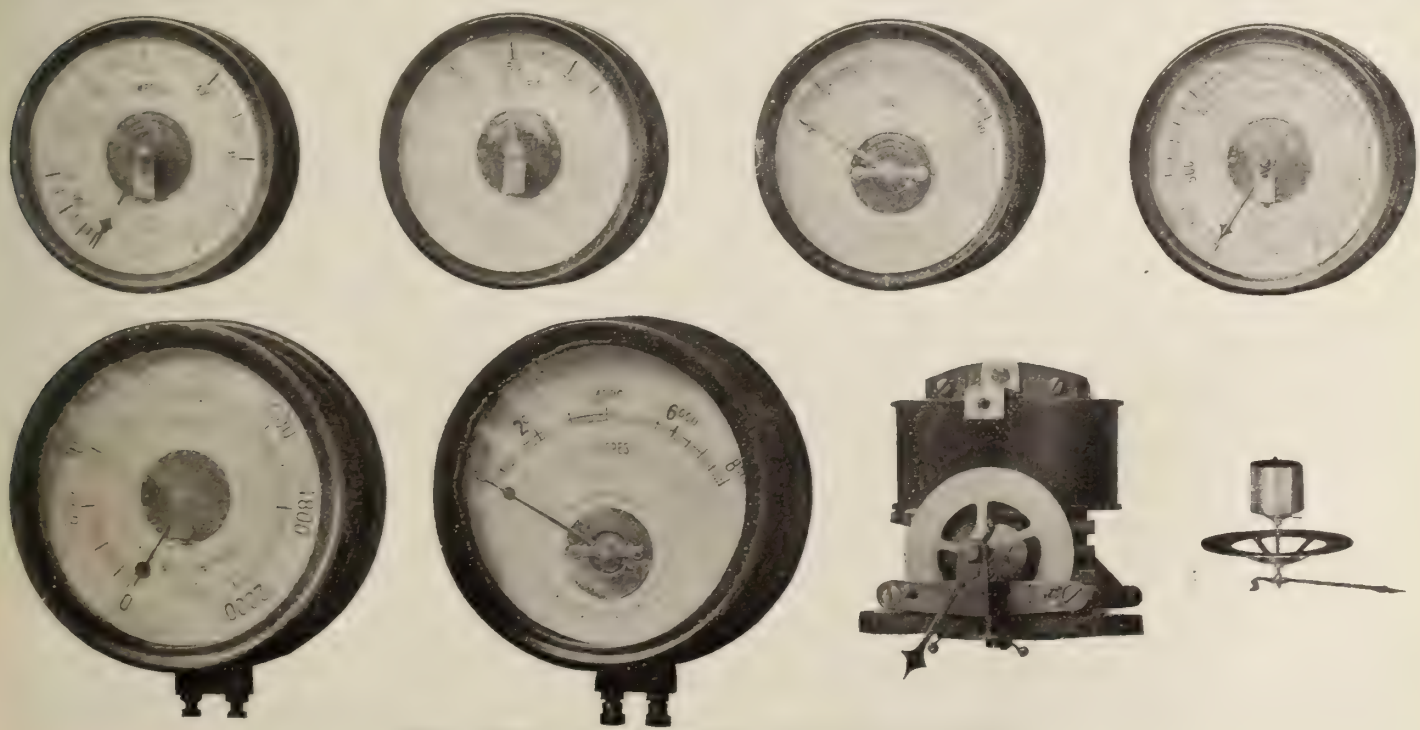
Ordinary 4-inch meter round pattern, 107 sq. in. ; scale 7¼ in. long.

Vertical edgewise meter covers 55 to 80 sq. in ; scale 12 in. long.

Horizontal edgewise meter covers 52 sq. in. ; scale 6 in. long.

This long scale feature is not depended on alone to make the meters easily readable. Instead of the usual metal front, a flat glass front is used, making it possible to thoroughly illuminate the dial from the front, without the troublesome reflections often encountered with the curved covers of the edgewise types of meters, and enabling the whole pointer to be seen, whereby accurate readings from a distance and from any angle are easily realized.

The type TM 9-inch, embody the same improvements, and meet the demand for a larger meter, where economy of space is not a prime consideration. There are no moving coils or connections, as they operate on the induction principle. A rotating magnetic field produced by current in stationary windings, acts on a light metal drum. The construction of meters on this principle, has a unmber of inherent advantages. The absence of a moving coil makes the use of exible or sliding conductors unnecessary, and greatly simplifies the construction, so that repairs are easily made. The lightness of the moving element makes the likelihood of damage to the pivot jewels remote, and reduce jewel wear to an inappreciable minimum. It is well known how seriously the proximity of heavy bus-bars affects moving coil and moving iron instruments, even when special internal shields or iron cases are provided. Freedom from the effects of external field and high torque, are among the advantages gained by utiliz-



NEW TYPES OF WESTINGHOUSE SWITCHBOARD METERS.

ing the induction principle, which has now come to be recognized as the most practicable in the case of alternating-current watt hour meters, and it is reasonable to assume, that the perfected induction indicating instruments, will in time replace all other types for switchboard service, as completely as the induction watt hour meters replaced all other types.

Meter Features.

A remarkable feature of the meters is the perfectly damped character of the readings. The pointer does not overshoot, even with full scale variation. This remarkable result is not obtained at the expense of accuracy, but by providing a special damping disk, moving in the concentrated magnetic field of two permanent magnets. This "superdamping" of the indications will be particularly appreciated by those using meters on circuits or generators operating in parallel, where there is likely to be a rhythmic interchange of power, or pumping. The damping required to prevent wide oscillations of the pointer on such service, can be obtained only by means of permanent magnet dampers. Compared with air dampers this method is not only more efficient, but so rugged in construction as to be practically "foolproof."

Exceptionally high torque is developed in the meter, and this makes possible the use of a substantial controlling spring. This spring is of a special alloy, and is tempered and artificially aged to insure permanence under all conditions. Extremely simple zero and calibrating adjustments are provided. Extremes in weight have been avoided. Wherever the principle of operation permitted, the weight has been made as small as possible, consistent with substantial and serviceable construction. To this end, the movement is made self-balancing to avoid the use of counterweights, the weight of the control spring is carried on the stationary support. All moving parts except the shaft are of aluminum, and the pointer is an aluminum punching of U-cross-section. On the other hand, wherever weight is required for strength, it is present. The result is a moving element, heavy enough not to be delicate, yet light enough to cause no damage to the jewels during shipment, and to cause no wear in use. The meters are highly sensitive and accurate without being delicate. The fact that the meter element can be removed from the case as a unit, allows all parts to be inspected without changing the calibration. The parts can be easily removed and replaced, and the absence of moving coil or flexible connections, makes this possible without danger of damage. The portable designs of Westinghouse indication meters have been thoroughly revised to eliminate the effects of temperature changes, either of the air or of the meters themselves, and inaccuracies due to variations in frequency. The frequency meters, power factor meters, and synchroscopes are of the well-known Westinghouse types, with the added improvements developed for the rest of these lines. The types SL and TL direct current meters, supplement the line of alternating-current meters and match them very closely in appearance. They have glass covers, the same type of cases and similar dial appearance, with scales 8-inches long. In fact, the scales of the seven-inch meters are as long or longer than those found in previous makes of 9-inch meters.

Operating Principles.

The meters operate on the D'Arsonval principle, of moving coil and fixed permanent magnets, which avoids all residual error. They differ, however, from most meters employing this principle, in having only one gap in the magnetic circuit. The moving coil pivoted at one edge, encloses a circular pole piece, and the other edge moves through the air gap. With this construction, the moving element can be removed and replaced without disturbing the magnetic circuit and the entire magnetic circuit is magnetized, "aged" and tested as a unit, thus preventing any variation in the strength. The shape of the permanent magnets is such as to shield the meter from external magnetic fields, and make it free from effects from nearby conductors. The moving coil is mounted on a light metal frame, the motion of which in the air gap of the magnets, produces a damping effect that makes the readings practically dead beat. As the coil is pivoted at one edge, its weight counterbalances that of the pointer; resulting in a naturally balanced moving element. This leads to long life of pivot jewels and accuracy of readings. The meters have exceptionally high full load torque.

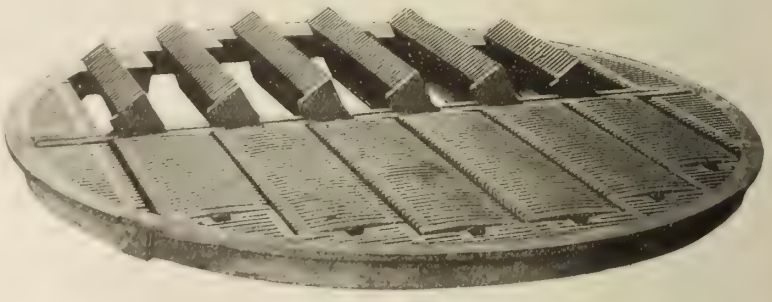
The dials of all the meters here described, are hand calibrated on white cards, thus insuring extremely accurate scales. The divisions are clear and open and the figures large and distinct.

CIRCULAR SHAKING AND DUMPING GRATE.

The grate which we here illustrate was recently supplied by the Boiler Repair and Grate Bar Co., 69 Adelaide St. East, Toronto, to the order of the Walter M. Lowney Co., Chocolate Manufacturers, Montreal. It is believed to be the first example of a shaking and dumping grate applied to a circular furnace.

The grate, whose diameter is 6 feet 3 inches, consists of twelve shaker bars and four segmental castings. It is easily adaptable and cheaply made-up to suit any diameter of furnace, since the shaker bars are standard patterns; the only parts requiring alteration for different diameters being the four segments. The back and front segments are exactly alike, as are also the side segments, therefore it will be seen that only two patterns require alteration.

Previous to the installation of this grate, the Lowney Co. used the best steam coal with forced draft. They now use a mixture of hard and soft coal screenings, and keep steam with ease under ordinary chimney draft. At the end of three weeks' trial the results attained were considered so satisfactory that a repeat order was placed to have a second boiler equipped.



CIRCULAR SHAKING AND DUMPING GRATE.

This grate is the result of many years' experience and development. It is a strong section, so that clinkers may be easily broken up, although, owing to the very liberal air space provided, and comparative coolness thereby obtainable, there is less tendency for clinkers to form than with other types. Further, the large percentage of air space enables all kinds of low-grade fuels, such as sawdust, small shavings, tan-bark, and coal screenings, to be economically consumed. The grate is readily adaptable, and shows equally satisfactory results, applied to gas producers, brick kilns, etc.

Among the victims of the Porcupine fire was Wm. J. MacLean, master mechanic of the West Dome Mines, and brother to D. J. MacLean, of the Jones Underfeed Stoker Co., Montreal.

LIBERTY
TUBE CLEANER

BOILER SCALE IS BOUND TO CAUSE YOU TROUBLE.

Why not remove it?

Its formation in your boiler tubes means a certain increase in your fuel bills, as it has been proved that one-eighth of an inch of scale means a quarter more fuel consumption than is necessary to produce the required steam under normal circumstances. "Liberty" Tube Cleaners will remove all scale rapidly and prevent accidents through tubes burning out.

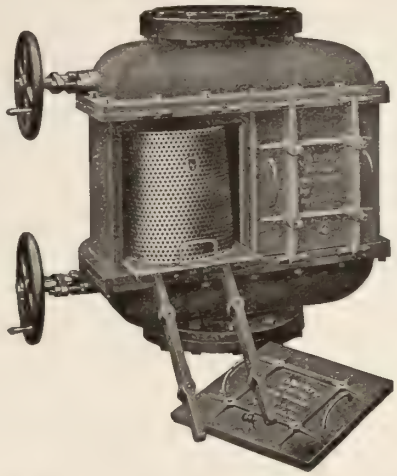
The "Liberty" is operated by air, steam or water, and is a wonderful time and money saver.

We would like to help you make your plant prosperous.

Write us at once for catalogue and prices.

Liberty Mfg. Co.
Susquehanna St.,
PITTSBURG : PA.

The Liberty Twin Strainer



THE TWIN
STRAINER

IS THE REAL PROTECTION FOR YOUR VALVES AND INJECTORS.

No matter how impure your feed water may be, the "TWIN" will always catch the foreign substances.

You can place it at any position without marring its efficiency.

The "TWIN" is the outcome of necessity, and every boiler room profits by its use.

Either side of the "TWIN" STRAINER can be easily cleaned separately, giving an uninterrupted flow of water.

The "TWIN" is the assurance of service.

Write us at once for full particulars and price.

Elliott Company
6902 Susquehanna Street
PITTSBURG : : PENNA.

Power Plant Developments

ONTARIO.

WEST TORONTO—West Toronto will install a [illegible] waterworks system.

COCHRANE—The Council [illegible] Electric Power Co. [illegible] power [illegible] current was turned on at the T. & N. O. depot recently and was highly appreciated by the few residents who were housed there.

QUEBEC.

MONTREAL—The board of control, Montreal, are calling for tenders on the construction of prefilters, filtered water reservoir and appurtenances in connection with the general filtration scheme for domestic water supply. Copies of tender, detailing the work required, together with plans and specifications, may be had from Hering & Fuller, 170 Broadway, New York City, on payment of a deposit of $5. Tenders [illegible] and October, 1911, is the limit time for return of tenders.

FARNHAM—The new power plant which has been under construction for the past year, is now practically completed and the machinery is being tested by experts. The old pumping station for the waterworks has been abandoned, and the power is now furnished from the new plant. It will take a few days yet before the new dynamo will be used for electric lights.

Farnham can boast of having one of the most modern and best equipped power plants in the country. It is capable of generating from 800 to 1,000 h.p., and as less than half of this amount is required by the town at the present time, Farnham will be in a position to furnish cheap power to industries which may locate here. A 24-hour electric service will soon be inaugurated, which will be a great convenience to the town in general.

HULL—Hull will spend $100,000 on extensions to its waterworks system.

MANITOBA.

WINNIPEG—Water will be turned on in the city's hydro-electric generating station at [illegible] for the first time by August 15, and the actual "juice" will be transmitted to the receiving station on Rover Street, in the city, on the same day. The regular steady supply of current for distribution to customers will commence on Sept. 15.

Two full units will be put in commission at first, generating approximately 4,000 h.p. each, or a total of 8,000 h.p.

According to present figuring three more units, making a total of about 20,000 h.p., will be ready and in commission by December 1, and the other three, making a total of eight, that can be accommodated in the main power house, will follow soon after.

Four of the five turbines being erected by the Jens Orten Boving Co. are complete, the governors are being erected and the fifth turbine is now being installed.

The exciters and generators for the first two units, being installed by Vickers, Sons & Maxim, of England, are all but complete, and a third is expected to reach the Point to-day. Two more are yet to be delivered.

Transformers, supplied by the Canadian Westinghouse Co., are installed complete, both at Point du Bois and the terminal stations in the city. Both the high-tension and low-tension switching apparatus, which the same company have supplied, is well advanced, and will be ready in plenty of time.

NEW BRUNSWICK.

CAMPBELLTON—The recently-completed round-house of the I. C. R., at Campbellton, N.B., has the following power plant equipment:

"WALSH" BOILER COMPOUNDS

A Composition that Absolutely Eradicates the Scale in Steam Boilers

"WALSH" Boiler Compounds are less costly than any other compound on the market. WHY? Because of its positive action, and on account of the small quantity required to keep the boilers absolutely clean when once the scale is removed. We guarantee that our compounds can be used with perfect safety where live steam is used, and will prevent any tendency towards priming or foaming. We guarantee that "WALSH" Boiler Compounds will remove every particle of scale from your boiler without the slightest injury to the tubes; that the same action will prevent corrosion and pitting, and preserve your boiler. Send us sample of scale (about two ounces) or half a gallon of feed water.

Booklet on the Scientific Treatment of Feed Waters on Application

THE WALSH CHEMICAL COMPOUNDING CO., 67 Bay St. North, Hamilton, Ont.

"KELVIN" BOILER COMPOSITION

Do you use Boiler Compositions? If not, investigate your boilers, as experience has proven that all boilers have a certain amount of scale. Every particle of scale decreases your boiler efficiency and increases your fuel bills. Kelvin Boiler Composition is guaranteed to remove all scale from any type of boiler without the slightest harm to plates or metals.

Kelvin Boiler Composition is supplied to all the mines of the Consolidated Gold Fields of South Africa, on a 5-year contract, also to The Dill, Russell & Chambers Co., contractors for the Filtration Plant, Centre Island, Toronto, etc.

To further advertise this reliable scale killer we solicit a 30-DAY FREE TRIAL ORDER. If this composition doesn't prove a money-saver return it at our expense.

Wm. Cooper & Nephews,
Toronto.

Gentlemen:

Some time since you sold us a quantity of "Kelvin" Boiler Composition. We liked it so well that I will ask you to send forward, addressed to this company, $15.00 worth, and you may make a sight draft for the amount.

Yours very truly,
E. V. TILLSSON, Mgr.

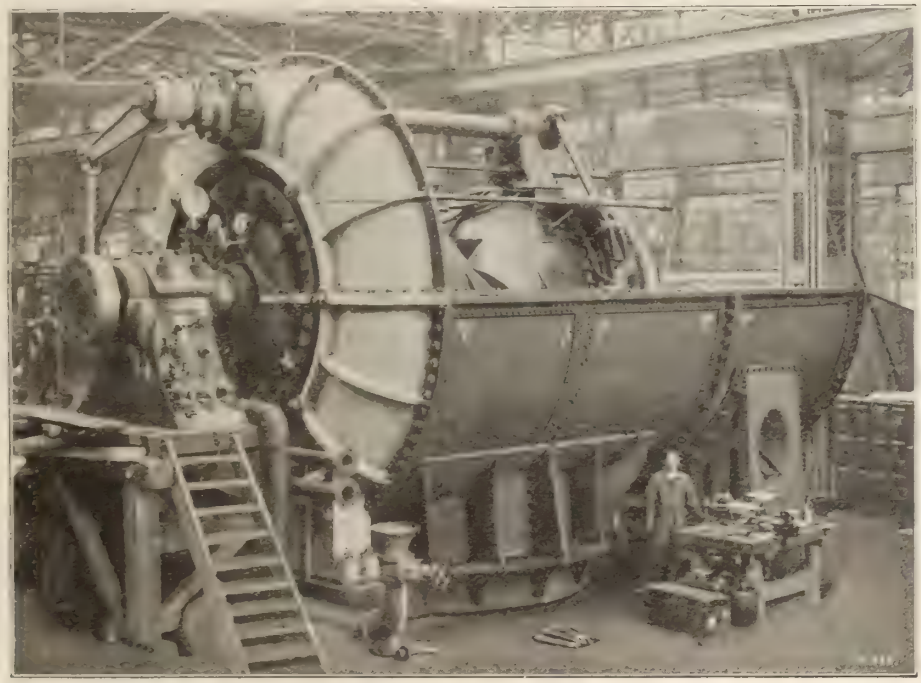
Wm. Cooper & Nephews, Toronto, Ont.

Don't fail to mention this paper in writing to advertisers.

Hydro-Electric Plants
Water Turbines

5,000 SUPPLIED. 2,000,000 HORSE POWER.

Any Out-put



Any Head

Two 13,000 H.P. Turbines, as illustration, on order for the Western Canada Power Company, Vancouver

ESCHER, WYSS & CO.
ZURICH, SWITZERLAND

CANADIAN HEAD OFFICE:
Room 408, Lumsden Building, Toronto

Phone: 234, Adelaide. Cablegrams: Neumuehle, Toronto

Don't fail to mention this paper in writing to advertisers.

The power house is a 40 by 51-ft. structure, connected to the round house proper by an enclosed passageway under the same roof with the general lavatory. The boiler room occupies a space 24 by 27 feet. The engine room is 38 by 22 feet. The equipment consists of three 100 h.p. Robb-Mumford boilers, one 10 by 16 by 9 by 12 in. compound duplex steam pump for the main water supply and fire protection, one 12 by 7 by 12 in. duplex end packed plunger pump for the boiler washout system, one 8 by 4 by 6 in. duplex end packed boiler feed pump, one air compressor, unit supplemented by a small emergency compressor, and one 60 k.w. 250-volt Crocker-Wheeler d.c. generator, directly driven by a Robb Engineering Co.'s engine, for general lighting purposes. Lighting is by means of incandescent Tungsten and arc lamps. A hot air heating system is provided.

The boiler washout system installed involves the use of a 12 by 7 by 12 duplex steam pump, controlled by a pressure regulator, a piping system with outlets between each pair of pits, and a blow-off pipe system with similar outlets. The pump and blow-off pipe are connected to a hot well located at the rear of the building, to which exhausts and other drips are taken from all parts of the plant. When a boiler is washed out the contents of the boiler flow into the hot well through the blow-off tank pipe, the pump is started, and being controlled by the aforementioned regulator, is stopped when the pressure in the system reaches 90 lbs. It immediately starts as the pressure decreases, due to opening any of the outlets throughout the building. In this way, a boiler can be washed out and refilled with warm water.

CATALOGUES.

Escher, Wyss & Co., Lumsden building, Toronto, have issued a pamphlet containing an exhaustive description, with illustrations, of the plant installed by them in the Adamello power station, the source of the water power, the intake on Lago d'Arno, the pipe lines, and the general scheme for electricity generation. The central power station, which is situated at Isola, has been built to house seven water turbines, each of 6,500 h.p., and is 63 metres long by 12.5 metres wide. The turbines have runners three metres in diameter, which are rotated at 420 r.p.m., and receive the water in a single jet 80mm. in diameter, with a velocity of 135 metres a second. They drive three-phase generators, built by Messrs. Brown, Boveri & Co., which deliver current of 12,000 volts to the transforming station at Cedegolo, where it is stepped up for transmission to Milan.

"Electrical Instalations in the Detroit River Tunnel Plant" is the title of a new 12-page 8x10 bulletin just issued by the Gould Storage Battery Co., 341 Fifth Ave., New York. This bulletin describes the Gould battery and allied regulating apparatus, by means of which current from the Detroit Edison Co.'s plant is made to pull Michigan Central trains through the new Detroit river tunnel. The engineering in connection with this installation is unusual and of special interest to those having excessive peak loads. A copy may be obtained by asking for Bulletin No. 12.

Cookson cast iron heaters and receivers with cut-out valves are described in a new 24 page 6x9 catalogue just issued by the Bates Machine Co., Joliet, Ill. This heater serves as a purifier, filter, oil separator, and condensation receiver, and possesses the special feature of being able to purify all the exhaust steam from the engines and auxiliaries. The new type of oil separator used on this heater is provided with cut-out valves that permit cleaning of the heater body without interference with the functions of the oil separator. This cataiogue is sent free on application.

Kerr Turbine Catalogue No. 19 (48 pages 6x9), superseding Bulletin No. 18, has just been issued by the Kerr Turbine Co., Wellsville, N.Y. This catalogue is a thorough treatise on the theory, construction, uses and advantages of small steam turbines for driving generators, pumps, blowers, and other small high-speed machines. Numerous data and illustrations make this catalogue a reference work that is well worth filing.

The Blackburn-Smith pressure filter is described in a new 16-page 6x9 catalogue just issued by James Beggs & Co. This filter is based upon small, easily-removable and renewable cloth-covered cartridges, for removing suspended matter from hot or cold water, and is useful in the clarification of a murky water supply, removing oil and slime from boiler water, or for clarifying the water in processing systems.

Editor Wanted

Graduate of McGill, Queen's or S.P.S. in Mechanical Engineering to do editorial work on "The Power House" and "Canadian Machinery." State age, particulars regarding practical experience, etc.

MacLean Pub. Co., Ltd.
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CONSERVE THE WATER POWERS
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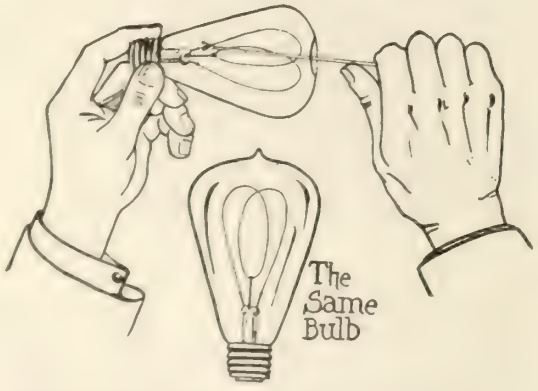

Instead of throwing away your burned-out filament lamps, put them carefully aside and we will pay you cash for them; or, if you prefer it, we will remake them for you. Either way you save money, so remember not to throw the lamp out.

The Dominion Electric Co.
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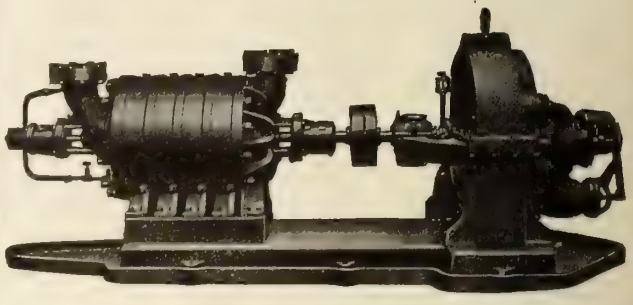

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Potato Scale Boiler Cleanser

Guaranteed to remove all scale from your boiler without the slightest injury to the tubes. Keeps the water in the boiler from foaming.

Send me a gallon of your feed water—we will analyze it and mix you a compound that will not only remove old scale but will prevent fresh scale from forming.

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We guarantee that **Walker's Electric Boiler Compound** will rid your boilers of **all** scale, and if used regularly will keep them absolutely free from scale without the slightest injury to either boilers or pumps. The many repeat orders that we are constantly receiving are evidence of success.

Realize economy by giving it a trial

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DEARBORN FEED WATER TREATMENT

Guard Against Scale

How are the conditions in your plant? Are you burning high-priced fuel and allowing this waste to go on day by day just because your boiler efficiency is marred by scale? Prevent it.

DEARBORN FEED WATER TREATMENT has proved to be an effective remedy for such troubles.

By keeping the tubes and sheets free from scale, Dearborn Treatment makes every shovelful of coal yield its utmost value. In medium cases it will save enough fuel to pay for itself many times over every year.

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Send us a gallon of Feed Water made especially for YOUR plant. We will analyse it and let you know the cost of this treatment ***WRITE AT ONCE***

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No new scale can form in any boiler in which "Eclipse" is correctly used.

Old scale is quickly removed by its action.

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In "Eclipse" Boiler Enamel we have a preparation which gives no heed to the class of water used, but in every case puts a filmy coating over the heating surfaces of the boiler, which makes it absolutely impossible for solid matter in any form to adhere to the iron. The scale-forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler in the form of a soft, soapy mud which will not burn or blister, and is most readily blown from the boiler.

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Gentlemen,—We have shipped you this date .....bbl. "Eclipse" Boiler Enamel, which, when used according to directions contained in our booklet, must give you entire satisfaction in your plant, otherwise you will not be required to pay for same. We leave it to your own sense of fairness to see that "Eclipse" gets a square deal. Under these conditions we are sure of the result.

"Eclipse" Boiler Enamel is guaranteed to be absolutely harmless to the boilers or the fittings. Being harmless, it is slow in its action on old scale, but it is deadly sure. Yours very truly,

Send for our booklet to-day

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HIGH PRESSURE
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VACUUM
CONDENSER
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The more severe the service and the more difficult your steam trap problem the more you need a "Morehead." Write us your conditions. We ship on 30 days' trial. CATALOG?

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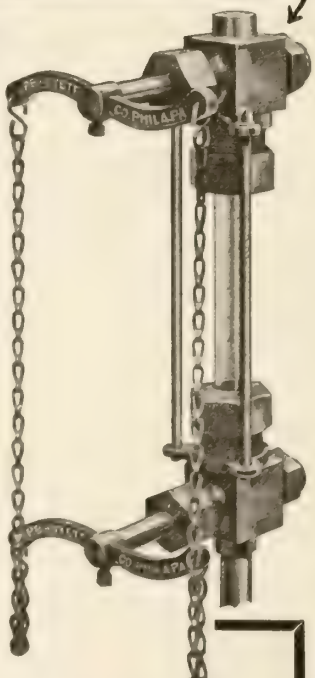
You can avoid accidents such as scalds and burns by installing on your boiler a

"P.B.H."
Quick Closing Water Gauge

This is the best form of prevention you can adopt, for when the glass breaks a pull of the chain shuts off both water and steam instantly.

The "P.B.H." is made of extra heavy steam metal, and is guaranteed easy to work and absolutely reliable.



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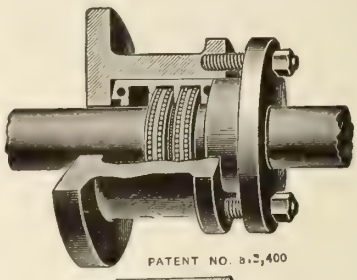

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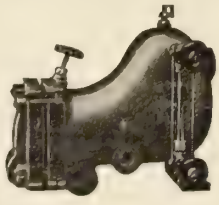

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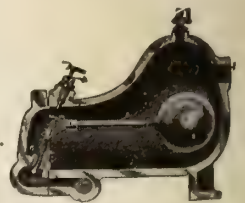
Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



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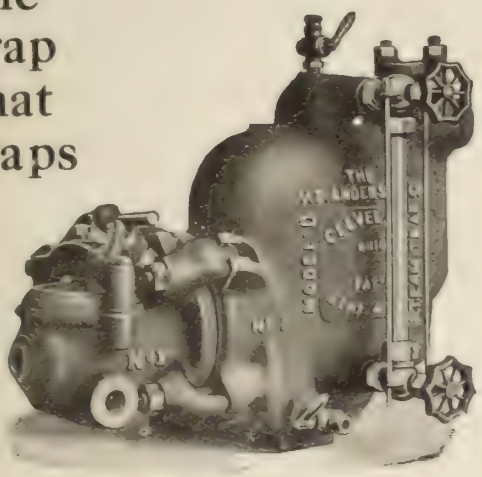
Discharges the Water AND Holds the Steam

The Trap That Traps



It is all that its name implies—a trap for steam from which steam **never** escapes, and water of condensation **invariably does.**

The body is constructed of close grained iron, with a valve which can be removed without disconnecting trap from pipes.

The valve and valve seat, of phosphor bronze, are simple in construction and easy of access.

The Anderson will deliver exhaust water against any back pressure of five pounds less than the steam pressure at the trap.

THE V. D. ANDERSON CO.

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To Be Able to Test the Valve
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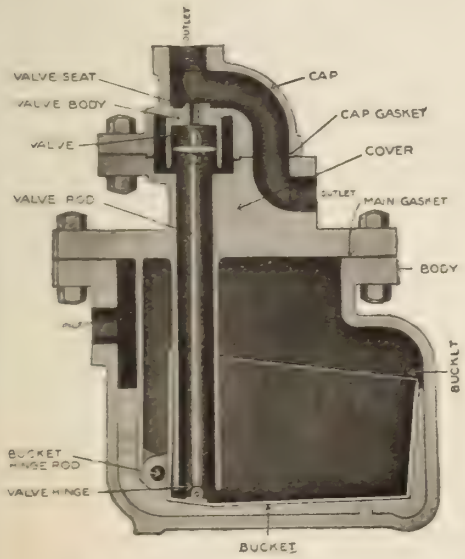
Without Time or Trouble.

Trade Mark. 4/S Registered



If the valves in your steam traps are leaking steam, and they probably are; if you have to take the time and trouble to take the trap apart to get at the valve, and the leak is 1/8 in. and your pressure 75 lbs., you are saying good-bye to at least 275 lbs. of coal every 9 hours. Why don't you buy

Strong Steam Traps

and know what is going on? Let us send you our catalog 14, explaining our valve testing without loss of time. Oh, yes! "On their merits alone we ask your patronage."

The Canadian Fairbanks Co., Limited

Montreal, Quebec, Canada

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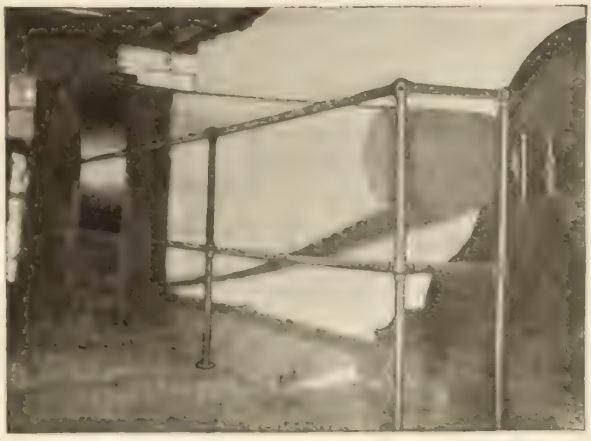

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Proving the value of Cling-Surface treatment over tightening of belts to prevent slip, is easy if you have a belted lighting generator on which the belt now runs tight. Slacken the belt until the lights flicker during the peak load. Then, without changing belt adjustment, put on Cling-Surface and note the steadiness and improved brilliancy of the lights. Continue to feed Cling-Surface to the belt at intervals as long as it will absorb. But long before the belt is completely saturated you can ease it up until the slack side runs quite loose and the contacts have been increased on both pulleys. A belt so treated and adjusted, pulls its heaviest load perfectly and usually would break before slipping. Here is an example:

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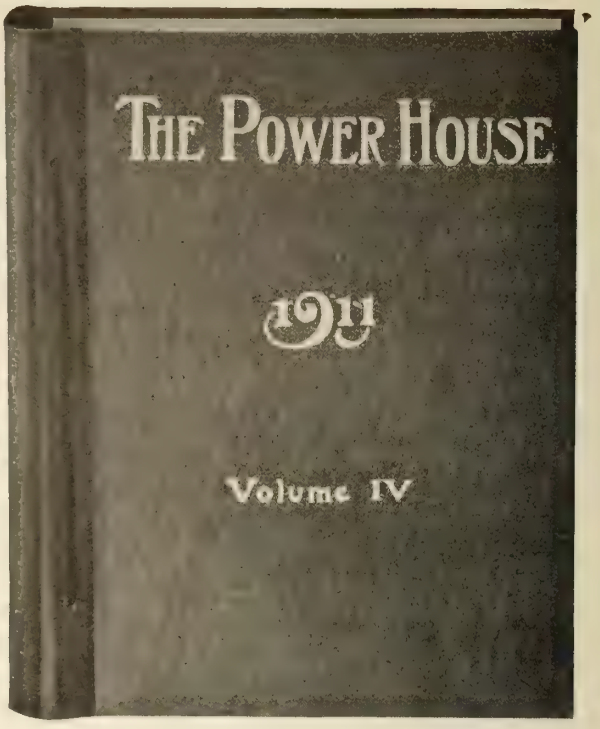
Primarily, Cling-Surface preserves the belt, lubricates the inside fibres, makes them healthy, flexible, soft and strong, protects both inside and outside of the belt from weather, water and fumes, in short, makes the belt highly efficient throughout the longest possible life.

Try Cling-Surface where other belt preparations failed. You will soon be convinced. Write for literature.

Cling-Surface Co

1057 Niagara Street - Buffalo N Y



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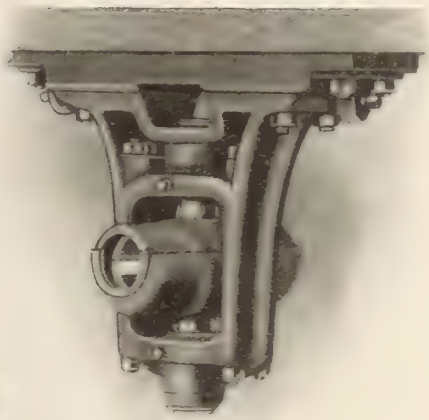

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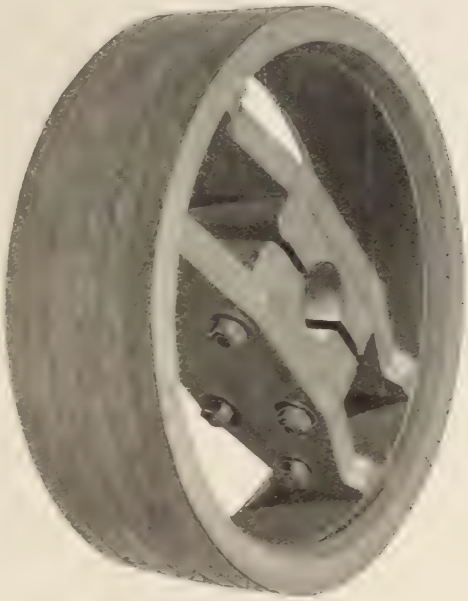
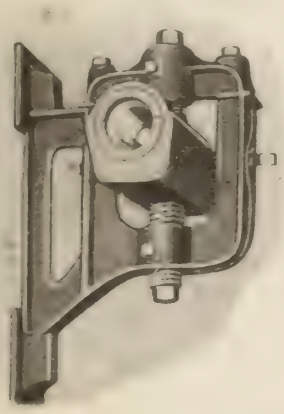
Have the arms properly tenoned into the rim, a perfect glue-joint being made, after which they are firmly doweled.



Each and every segment of Rim is thoroughly nailed



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Sole Eastern Agents for Wood Pulleys—THE A. M. ELLICOTT CO'Y. Montreal

The ELMIRA MACHINERY & TRANSMISSION CO., Limited

ELMIRA ONTARIO

TO THOSE WHO ARE NOT FAMILIAR WITH

Stephenson Bar Belt Dressing

This Advertisement is to announce that there is such a thing on the market.

Stops Slipping. Preserves a Belt. Used for 24 years in United States.

Red Label for Leather Belts. Green Label for Canvas and Balata Belts, and Brown Label for Rope Drives, which is Waterproof.

WE WILL GLADLY FURNISH ENOUGH DRESSING FOR A FAIR TRIAL

STEPHENSON MANUFACTURING CO.

ALBANY - - NEW YORK

D. K. McLAREN'S

GENUINE BRITISH OAK-TANNED

LEATHER BELTING

wins out in competition with any Belting on the market, because it can be relied on to cling close to the pulley, and to transmit all the power your engines can develop.

In use D. K. McLaren's Oak-Tanned Belting lasts longer, and gives more uninterrupted service than any to which you can compare it.

It is tanned by the original Oak Bark Methods, and no chemicals are used that would destroy its toughness and endurance. Only the choicest close trimmed hides are used. Our Belting is absolutely guaranteed.

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LEATHER BELTING

Here is a Belting that we guarantee to stretch less and hold its general efficiency longer than any Belting yet produced.

Why? Because Belting experts select the hides and do the tanning and manufacturing, resulting in an unusual quality in every inch—a quality that is equal throughout.

All Belting may look alike to you. But why not protect yourself against the unreliable ones by buying the guaranteed kind?

"CLIMAX" is sold under the broadest guarantee.

For further evidence of the "CLIMAX" quality write us for letters from present users – they will convince you that our Belting is the greatest of economisers.

Write for a trial order—it will cost you nothing if unsatisfactory.

Sadler & Haworth

ESTABLISHED 1876

MONTREAL, 511 William Street TORONTO, 27 Melinda Street
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☞ TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN ☜

Reliable and Efficient
Power Transmission

The "CAMEL HAIR" Brand Belting will last longer, stretch less, and transmit more power than any belt manufactured.

Service has proved that it has strength that is greater than double Leather Belting that is manufactured.

"CAMEL HAIR" Brand Belting is more reliable, more efficient, and lower in cost than any other. W H Y ?

Because ! It has no plys to open up and fall apart.
Because ! It has no rubber or gum to heat and peel.
Because ! It lasts longer than any other belt on the market.
Because ! It slips just one-half that of any other belting.
Because ! It will run equally well in damp, wet, or a dry atmosphere.
Because ! It is less affected by acid fumes and high temperatures than any other Belting.
Because ! It is uniform in thickness and runs true.
Because ! Of its great strength—almost twice that of best oak-tanned double leather.
Because ! It requires much less attention than other styles of Belting.
Because ! The stretch comes out quickly, and after taking up once or twice (according to load and nature of run) requires little or no more attention.
Because ! It transmits more power than any other Belting.

Beware of Imitations

We have many imitators—which proves the superiority of "CAMEL HAIR" Brand Belting

Write for full particulars and prices—if taken seriously they will increase your trade.

F. REDDAWAY & CO.

Sole Manufacturers

56 St. Francois Xavier Street : : MONTREAL, QUE.

GOING SOME

Manufactured in Commercial Sizes all the way from 12 x 3 up to 120 x 48.

"That's certainly going some," a gentleman said when we told him about the 76x20 POSITIVE Combination Split Wood Rim Steel Center Pulley we have running in a mill at 8,300 feet per minute rim speed.

Well, we admit that it's traveling right smart. In fact, we don't like to put a pulley out to roll around so merrily. Yet this selfsame pulley has now been whirling at this gait for over eight months without a whimper.

A POSITIVE Pulley of the size mentioned weighs 530 lbs., against 3,960 lbs. for an iron pulley. That s why the POSITIVE Pulley stands the tremendous centrifugal force, which would burst the iron pulley. We emphasize that we combine *maximum strength and lightness.*

Bear this fact in mind. Some day you will be in the market. Then when you look over pulleys of every make, you will come to the conclusion that after all the best pulley for you is the POSITIVE Pulley, the pulley that "whirls without a whimper," because it is just so much higher grade than all the rest—the pulley that is "going some."

The Positive Clutch & Pulley Works, Limited

American Works: Buffalo, N.Y.

11-13 Jarvis Street, TORONTO, ONT.

"Leviathan" Service Guards Against Belt Dissatisfaction

Service is a new thing to the average belt buyer, but a moment's thought will show its importance.

Consider the old way of buying a belt.

Say you need a new belt—you figure the size you think will answer the purpose—

Then perhaps you buy of the dealer or the jobber or some [illegible]—

Who is interested in profits for himself rather than service for you.

He will give you the belt you ask for, whether the most economical size or not, possibly because he does not know [illegible]—

If the belt lives up to hopes—you're lucky.

If it doesn't—you make the best of things, put up with time waste, shut-downs for tightening, power waste, excessive maintenance cost.

Contrast this with the "Leviathan" Service method of belt selling—.

40 men on the road in all parts of the country—

They study your proposition—then advise on what belt you need—

Then you buy **direct from the maker—**

Who is as vitally interested in the results you get, as you are—

And follows the belt until assured that it has given you **the service you paid for—**

Who **must** give you complete satisfaction, because all hope for further business rests upon the service each belt renders.

Then you simply can't buy a "Leviathan" misfit belt, and that means freedom from the so-called belt troubles which the average belt user complains about.

There you have the advantage of "Leviathan" Service—a service that applied to your proposition would mean better results from your belts at less cost—whether your belting proposition is transmission, elevating or conveying.

The New "Leviathan" Conveyor Belt

A decided improvement over any belt now used for conveying purposes.

The new black composition which we have perfected impregnates and coats every fibre, making the entire belt waterproof, acid-proof and capable of standing high temperatures.

In rubber belts, when the rubber coating is cut and worn through, the canvas is soon affected by the dampness and the whole belt weakened, for it's the canvas which contains the strength of a rubber belt.

Further protection is afforded the fibres of this New "Leviathan" by an added coating of the new composition on the carrying side of the belt.

This coating is elastic, but far superior to rubber coating in that it will press together again when cut.

The whole belt is a superior belt—heavier, lasts longer, carries more material, and requires less attention than the belts in general use.

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Main Belting Company of Canada, Limited

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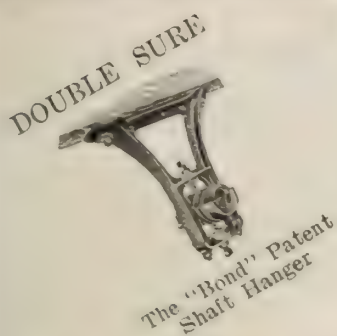

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Make Assurance "DOUBLE SURE"
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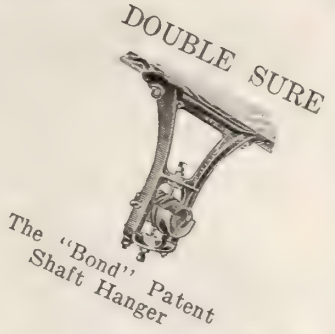
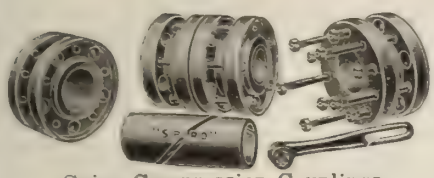
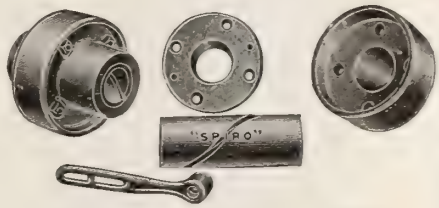
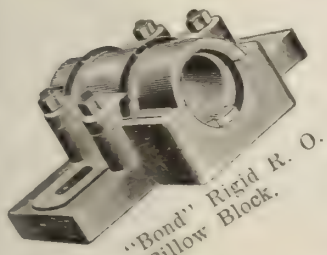


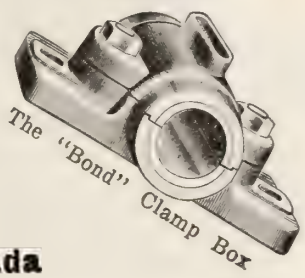
The "Bond" Patent Shaft Hanger


Spiro Compression Couplings

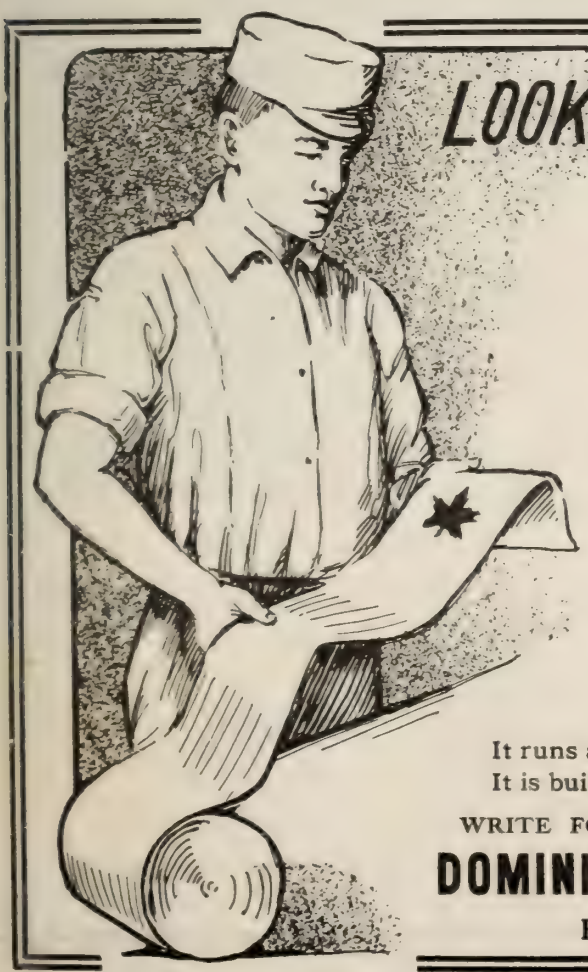


Spiro Compression Couplings


The "Bond" Rigid R. O. Pillow Block.


The "Bond" Clamp Box

Canadian Bond Hanger & Coupling Co.
LIMITED
Manufacturers
Alexandria - Ontario - Canada



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It runs absolutely true on the Pulleys.
It is built of plies of selected duck.

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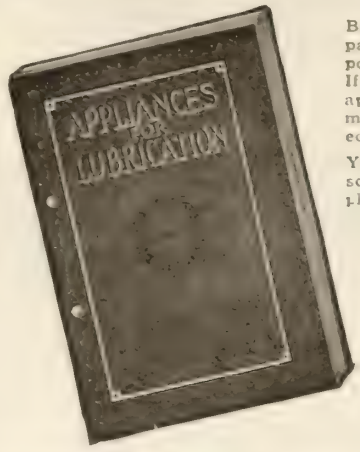

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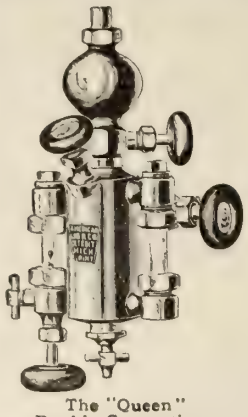

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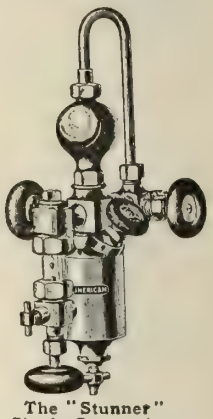

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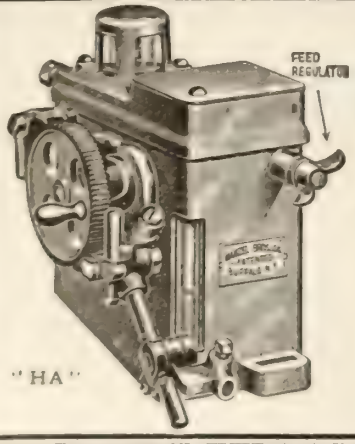

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The new Detroit Push Pump has no spring check valves.

When a hand pump will not work it is nearly always because of the check valve's failure to operate. A valve with springs is apt to get out of order at any time. Heat and wear will eventually weaken any spring, and when the spring fails the pump is useless.

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Detroit Push Pumps are free from the troubles that come to the ordinary hand pump. They embody all the refinements and advantages made possible by many years' experience in the study and manufacture of lubricating devices.

Plungers are carefully ground and fitted, obviating any chance of leakage. All parts are large and carefully fitted. Handles are large and keep cool. The pumps are beautifully finished, strong and substantial, and suitable for any kind of service. They will stand up under the most severe usage.

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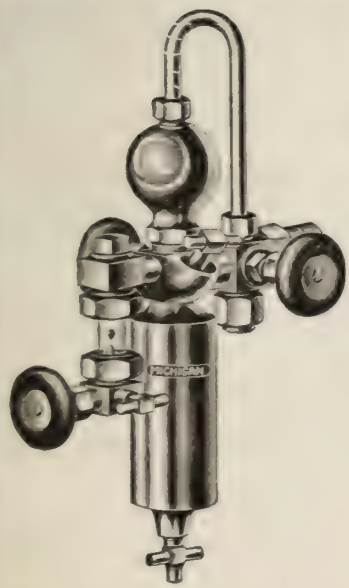

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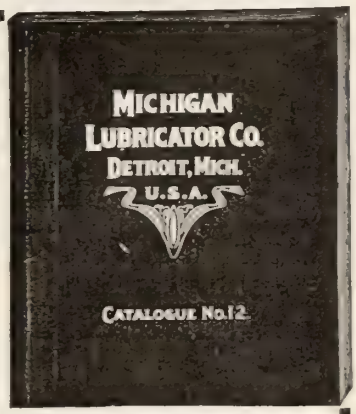
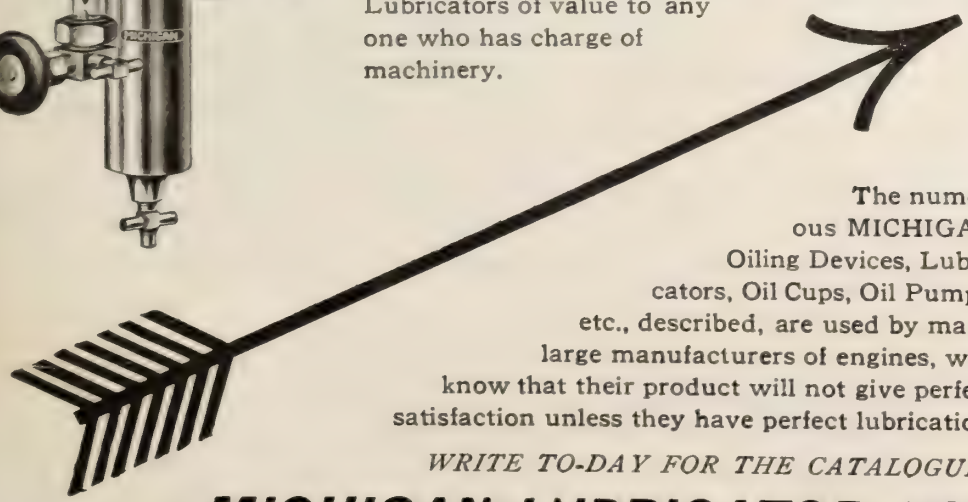
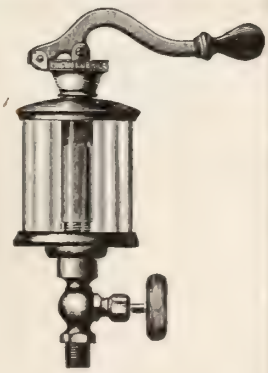


It contains 105 pages of descriptive matter, and illustrations of our Lubricators, besides giving general information about Lubricators of value to any one who has charge of machinery.





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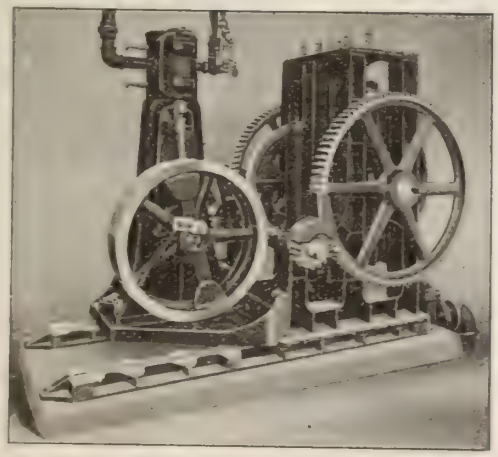

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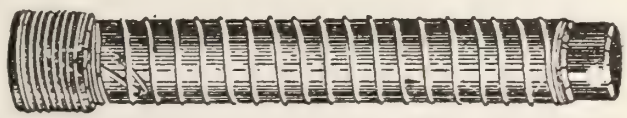

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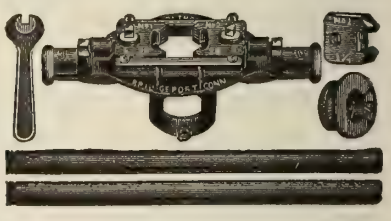

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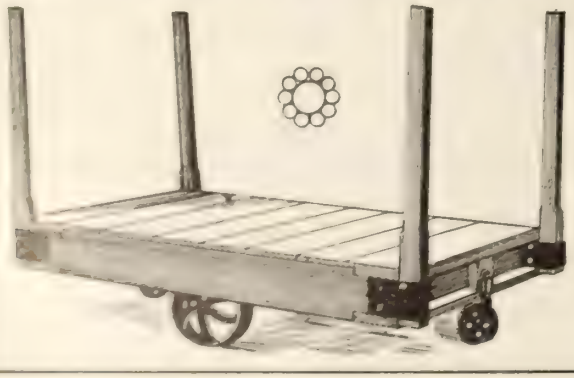

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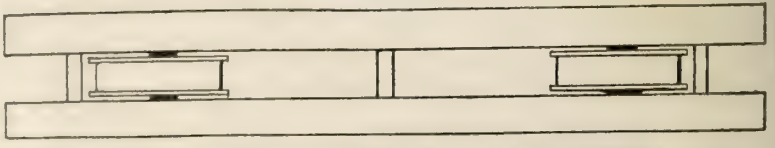

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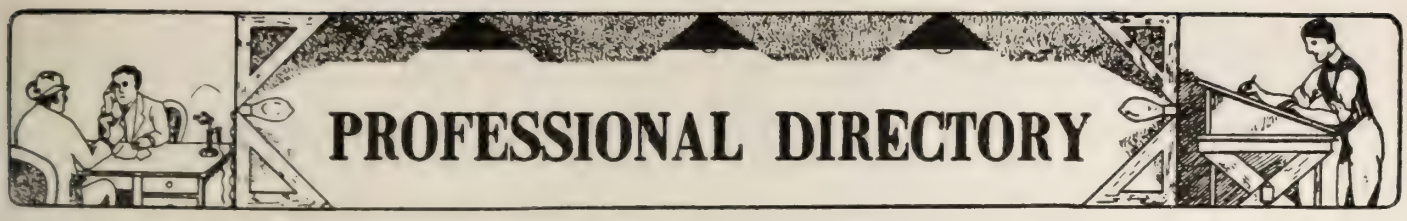

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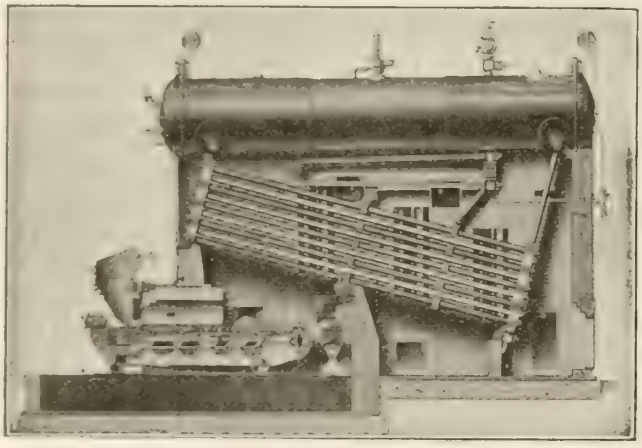

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140

ANALYSIS OF GLENBOIG FIRE BRICK

The undernoted analysis of the Glenboig Brick was made from a sample taken by Sir Frederick Abel, F.R.S., himself, from the bulk, supplied in large quantities to the Gun Factory, Royal Arsenal, Woolwich.

Description of Fire-Clay	Silica	Alumina	Iron Peroxide	Alkalis, Loss, etc.
Glenboig	62·50	34·00	2·70	0·80

ANALYSIS OF GARTCOSH FIRE BRICK

CITY ANALYST'S LABORATORY, 138 BATH STREET, GLASGOW.
31st August, 1880.

CHEMICAL ANALYSIS of a SILICA BRICK, received on the 21st inst. from Gartcosh Fire-clay Works—

Silica	87.06
Titanic Acid	Trace.
Alumina	11.24
Peroxide of Iron	.69
Lime	Trace.
Magnesia	Trace.
Potash	.61
Soda	·33
	99·93

This Brick is made from a mineral which appears to be a soft sandstone. It is well adapted for withstanding the most intense temperature in all furnaces, with the exception of those in which it would come in contact with free alkali; and for many purposes it will be found much superior to the best ordinary fire-bricks. (Signed) WILLIAM WALLACE.

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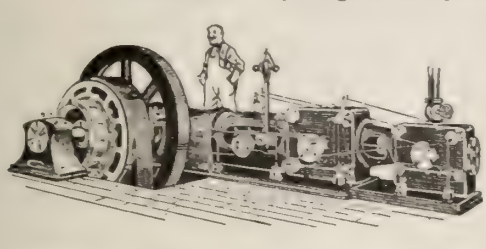

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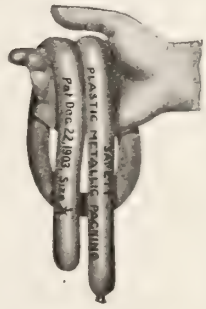

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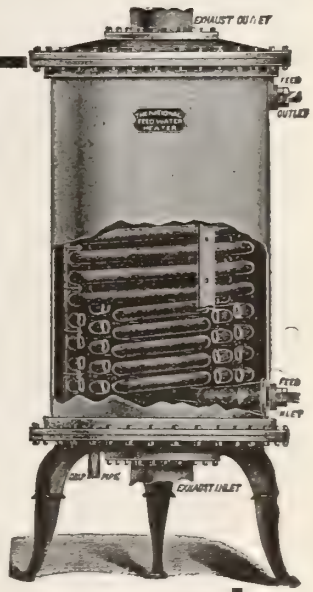

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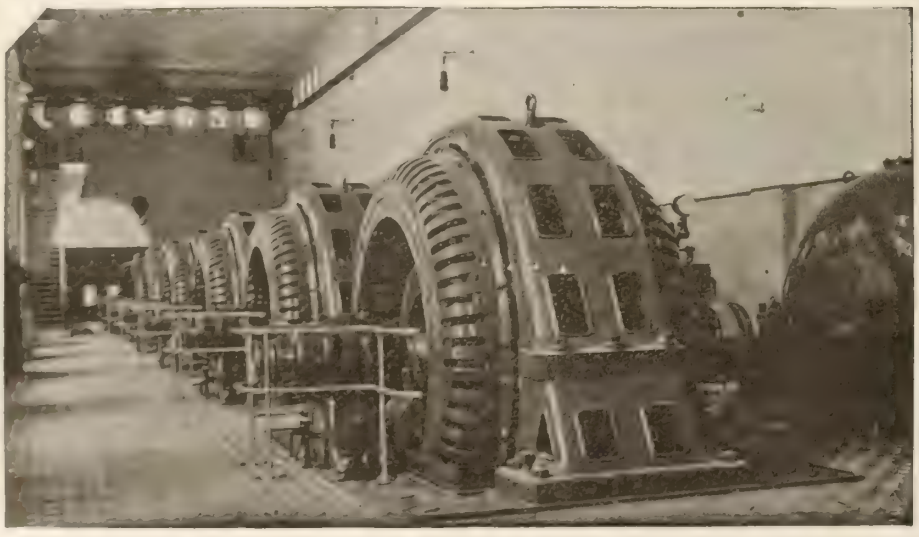

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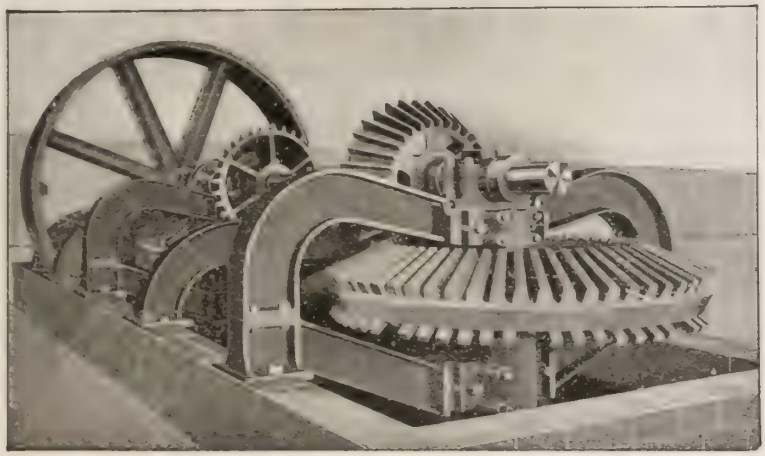

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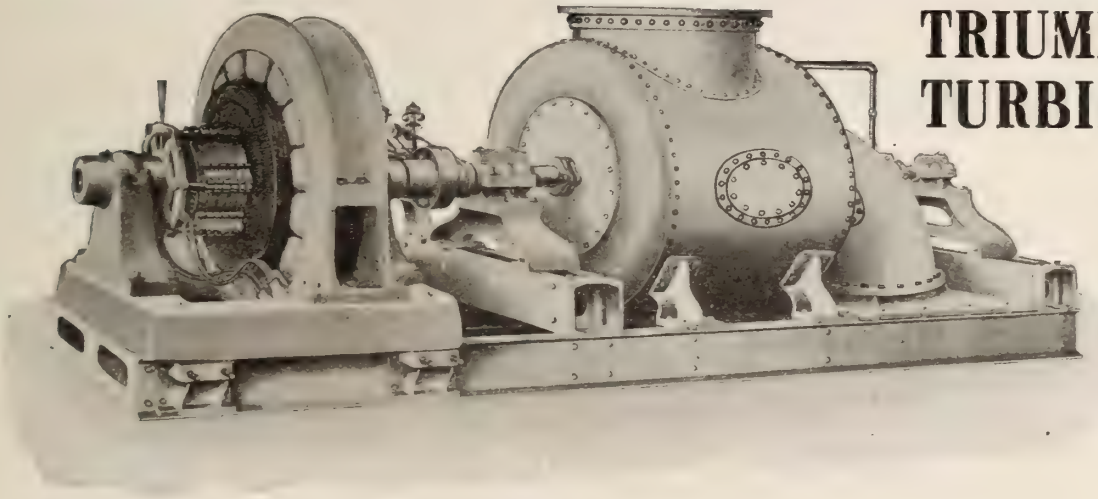

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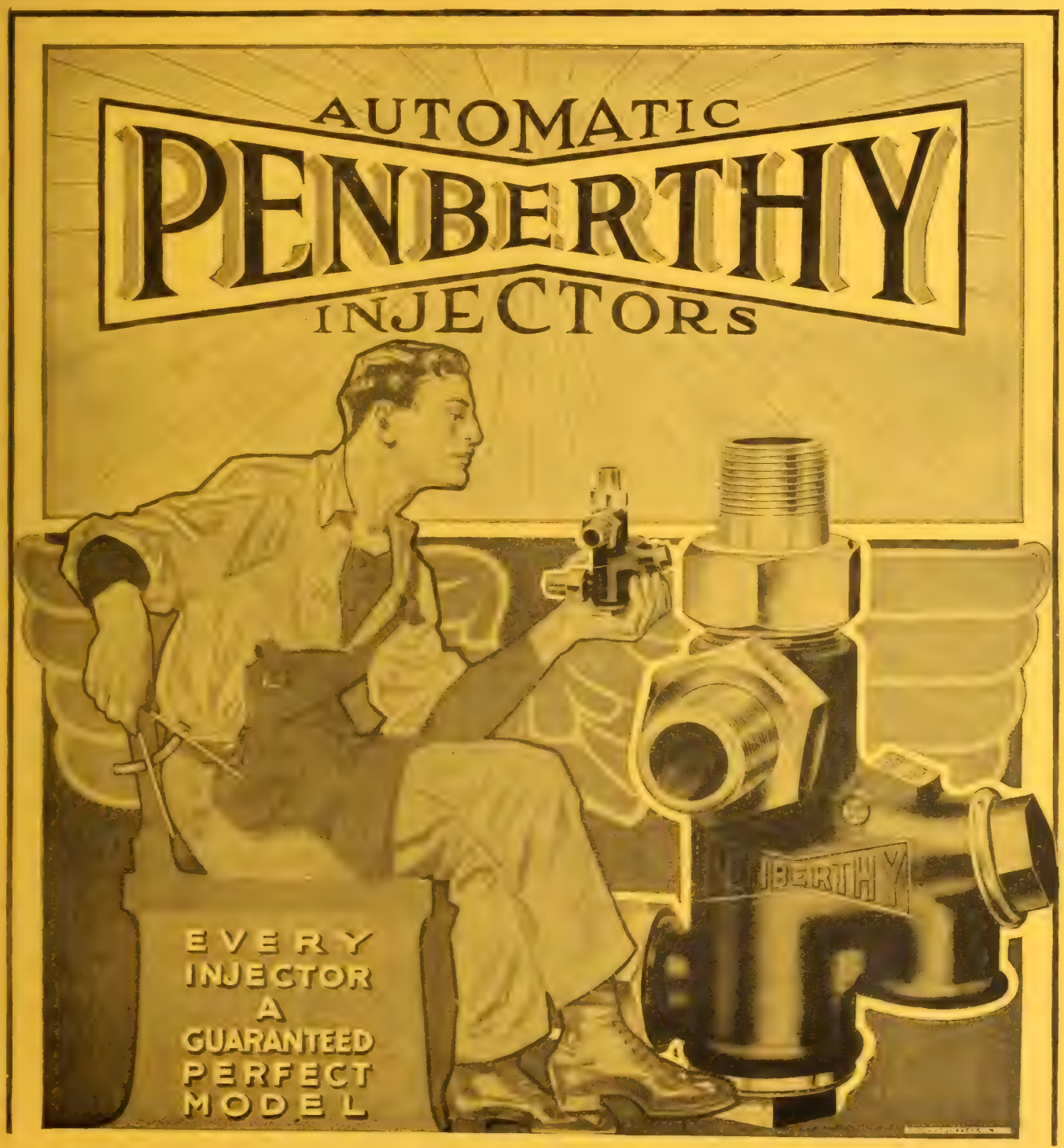
Vol. IV. Publication Office, Toronto—September, 1911 No. 9



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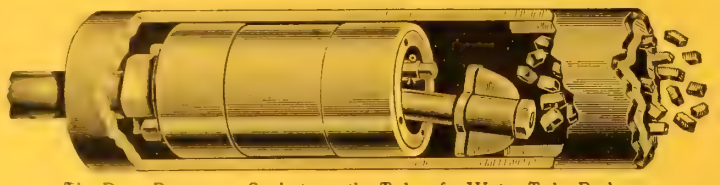

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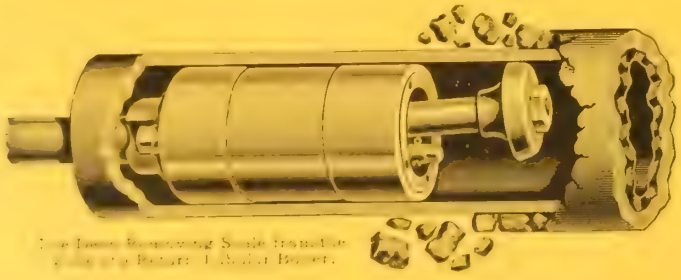

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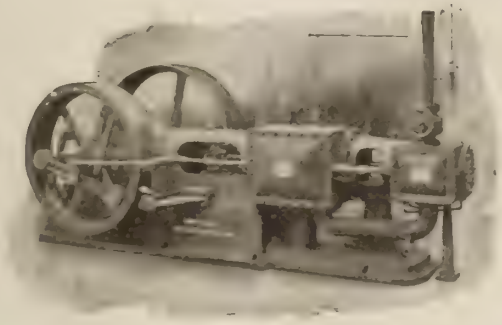

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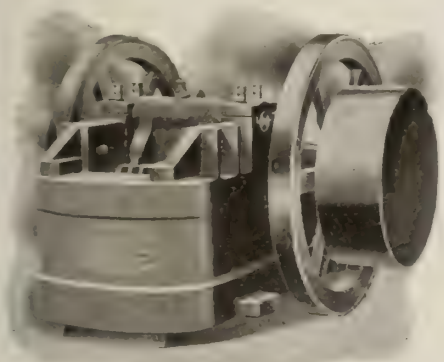

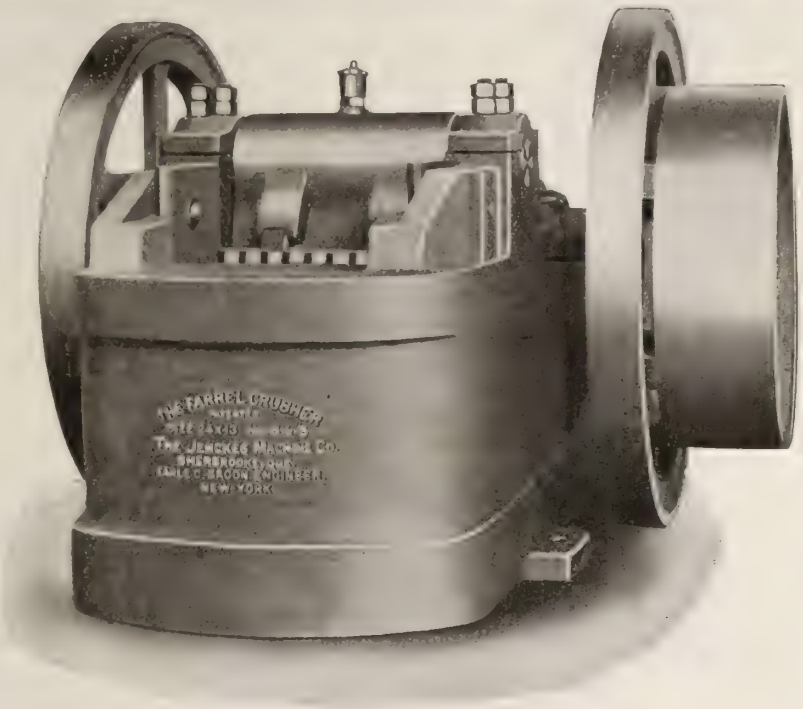

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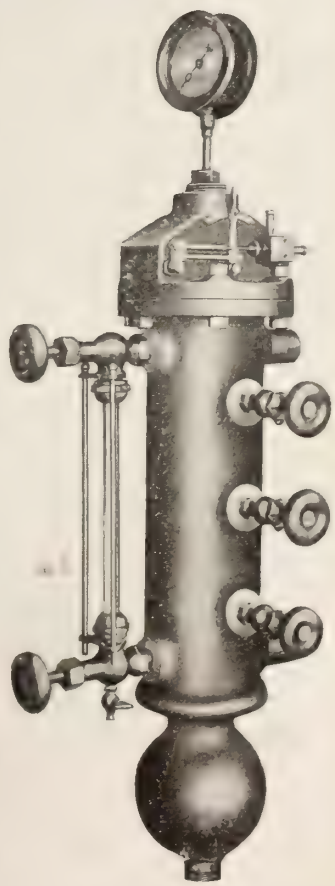

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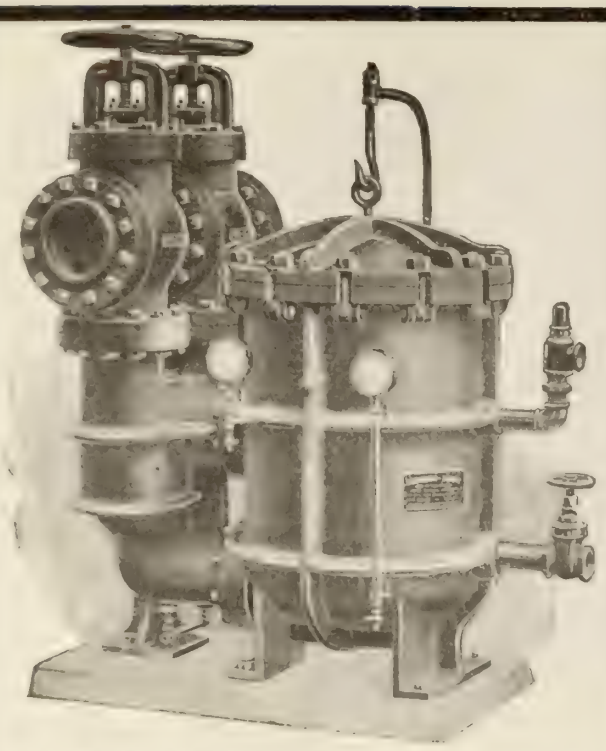

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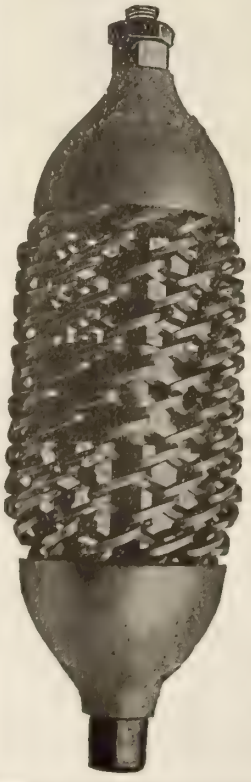

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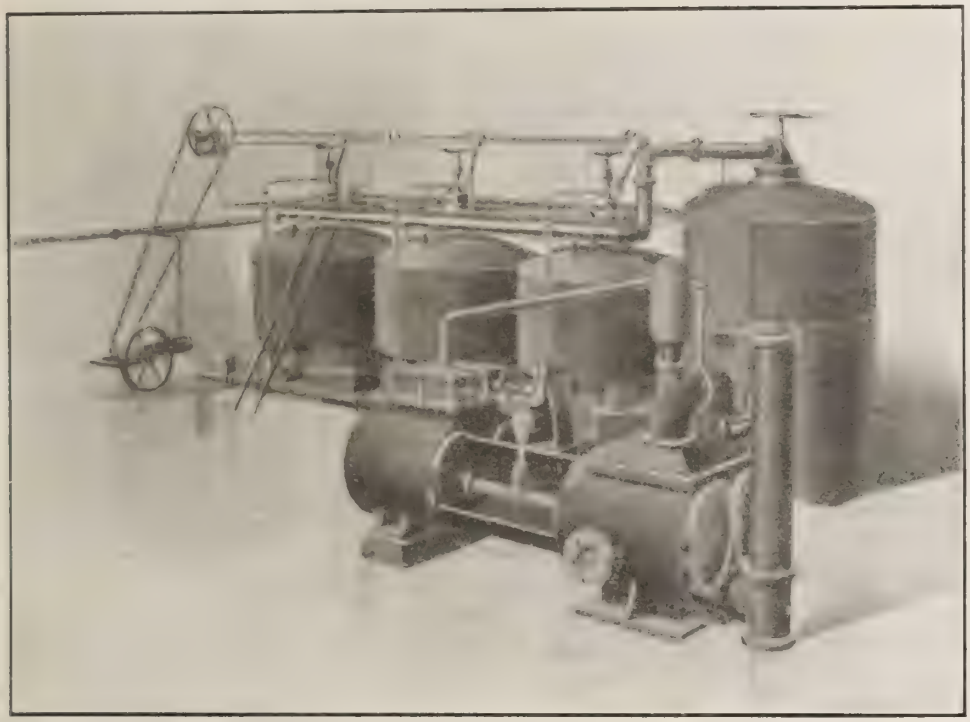

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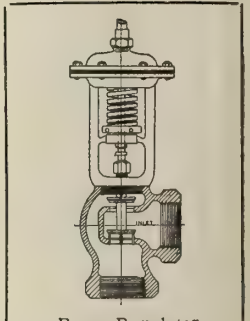
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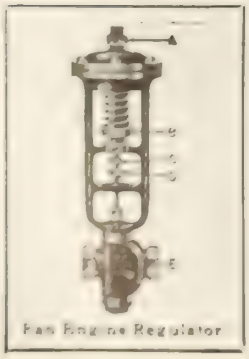
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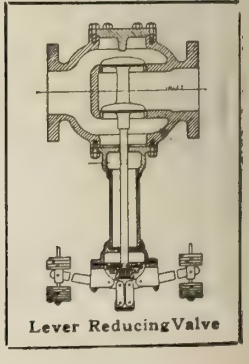
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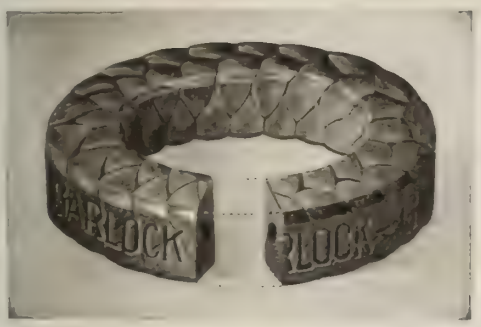

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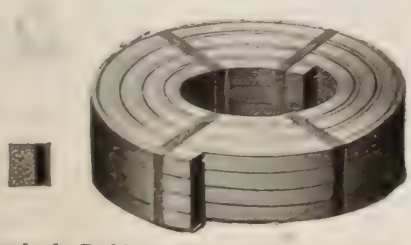

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The Garlock Packing Co.

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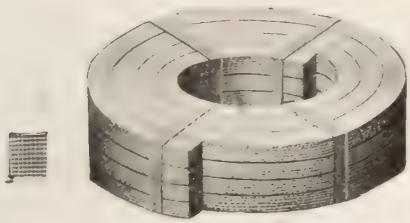

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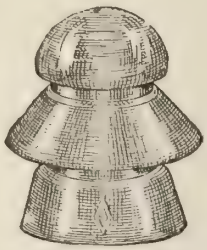

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Then, it will be up to you to give them a try-out that will be conclusive—a trial that will show either that you don't want a Goetze's No. 2 Gasket in your plant, or that you want one of them in **every** flanged pipe joint you own. And **one** in a joint is enough—yes, even where **several** of some other kind have failed to hold. Goetze's Elastic Corrugated Copper Gaskets, with Asbestos Lining No. 2 ("Goetze's No. 2," for short) **cannot** blow out, burn out or give out in **any** way. No other one thing can save you as much trouble, time, coal, money.

If our claims are true, you can't afford to be without Goetze's No. 2 Gaskets. If they are not true, you can disprove them at **our** expense. Send for a supply of Goetze's No. 2 Gaskets to-day, and find out for yourself, once for all, **now.**

Do **You** Have the Usual Leaking Valves in **Your** Plant? Have **you** found it difficult to get a valve gasket that would pack tight and not go to pieces after a few days' or weeks' service? Are you sufficiently tired of such trouble and expense to try a Valve Gasket that comes to you with a **guarantee?**

If we can't prove every word of every claim, we don't want your money.

Are you **willing** to try such a Valve Gasket at **our** risk?

Then Write Us—To-Day—For A Supply Of Goetze's Copper Valve Gaskets on 90 Days' Trial

and **try** them.

Goetze's Copper Valve Gaskets are for valves of Jenkins and similar types. They are made from **chemically pure copper**, with a core of the **best Asbestos.** These materials form a cushion with sufficient elasticity to insure tight closing, yet with the firmness and strength to resist the heat and pressure which so quickly disintegrate and destroy ordinary rubber or "composition" gaskets. The valve seats will close **tightly** on **this** gasket without injuring it or themselves.

You can put them in without removing valves from piping. **And then you can forget them.**

Made of **Nickel** and Asbestos if you want to use them with acids, etc.

Send for a supply of Goetze's Copper Valve Gaskets and **try** them for 90 days at **our** risk. Merely give sizes wanted, number of each, and whether with two flat sides inside, or with round hole.

Ask for Catalog of Packings for All Power Plant Purposes.

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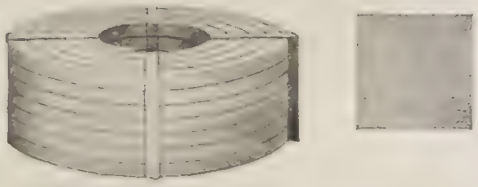

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by diligent workmen, combined with the use of the best materials and our improved lubricating compounds, produce packings that are unexcelled in quality.

We handle the highest grade packing for every purpose.

Our packings are an **absolute insurance against even the slightest friction,** allowing your machinery to move smoothly, and saving in repair costs as well as in power production.

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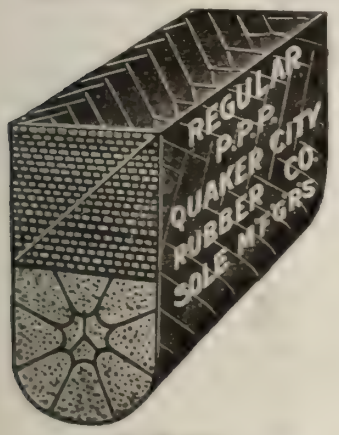

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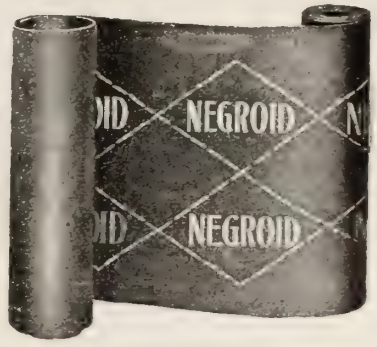

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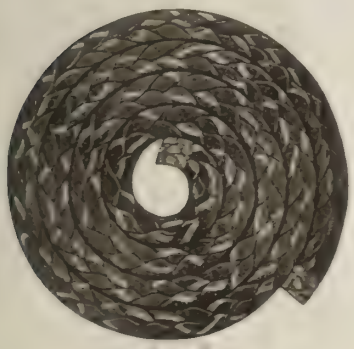
SHEET RUBBER PACKING.



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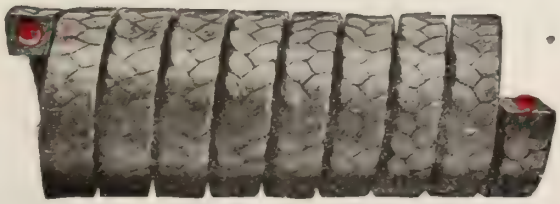

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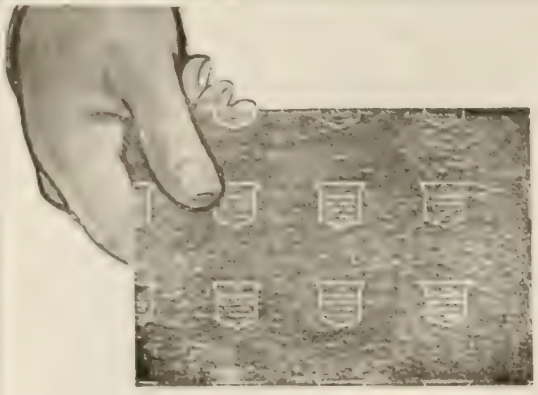

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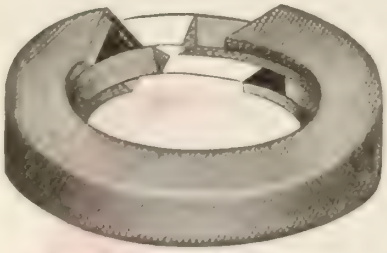

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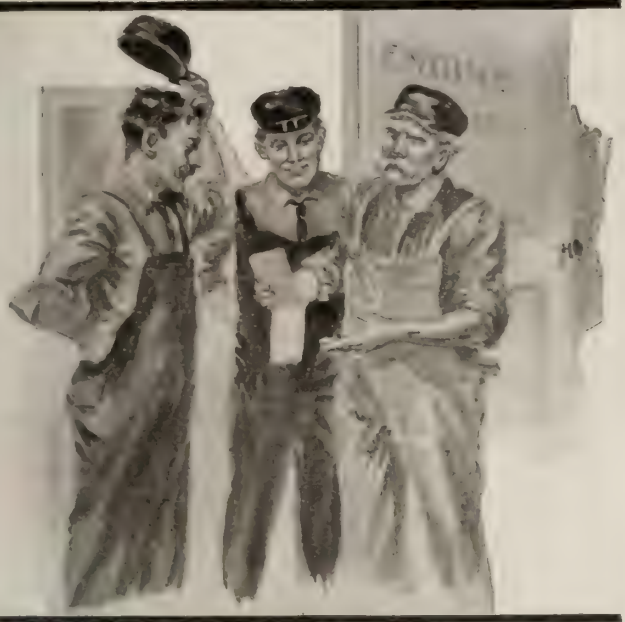

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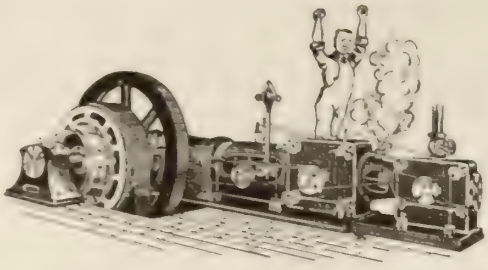

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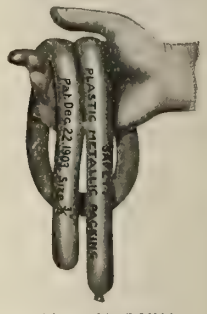

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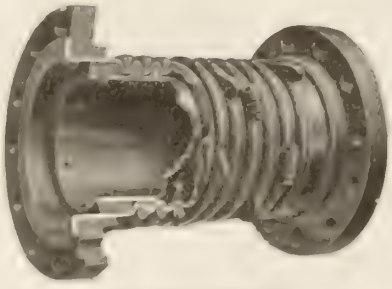

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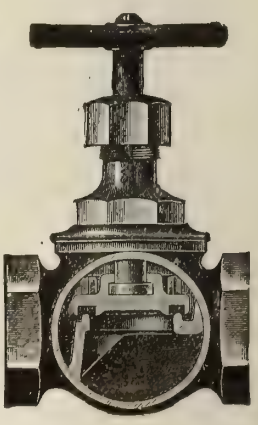

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TRADE JENKINS MARK
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"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

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CONFORM WITH THE NEW CANADIAN BOILER REGULATIONS AND ARE APPROVED FOR USE IN WESTERN CANADIAN PROVINCES, INCLUDING BRITISH COLUMBIA, ALBERTA AND SASKATCHEWAN.

THE LINE APPROVED INCLUDES GLOBE, ANGLE, CROSS, GATE, BLOW-OFF AND POP-SAFETY VALVES, WATER GAUGES, GAUGE COCKS, ETC.

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In the interest of *safety* alone, make sure that specifications for your steel valves and fittings read thus:

"The castings must be NELSON Steel."

Because NELSON Steel is the *only* steel made that is *guaranteed* for valves and fittings for Superheated Steam.

In the **NELSON** Steel Foundry no Castings are made except for pressure work. The sole requirement is *quality*, no matter what the quantity or cost. *Other Steels* are made in foundries where they make anything from locomotive frames to car couplers, where only large quantities of *cheap* castings is the main purpose. The grade is low, because the castings are cheap.

Tapping a NELSON Steel Furnace.

We are the *only* Valve Company with *its own* acid open hearth steel foundry. We were driven to make our own steel because we couldn't buy guaranteed steel castings from any steel foundry in the United States. We found that, with skill and extra thorough carefulness, steel castings *could* be made, and made *regularly*, back of which we could safely put the **NELSON** guarantee.

This is one strong reason for the general preference for the **NELSON** Steel Valves.

But if you decide to use Steel Valves or Fittings other than **NELSON**, *remember* that we are willing to make the **NELSON** Steel for other Valve Companies if you will *specify it.*

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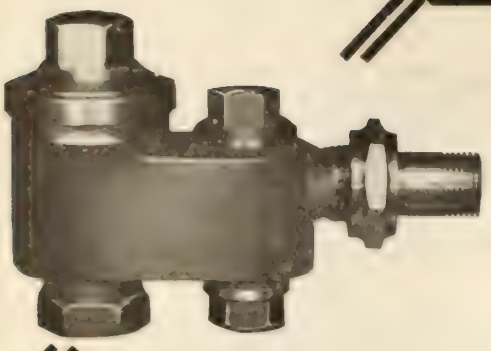

THE "ECONOMIC" VACUUM VALVE

WILL MAKE

Your Heating System Positive

The construction of this valve is very simple and can be easily cleaned.

There are two chambers, in the first of which the dirt is screened from the condensation, and is easily removed.

It is the latest in pattern in every respect, and by a single operation you can attach the Vacuum Valve to the old gravity type of heating apparatus, keeping the radiators always hot, with an economy in fuel consumption.

Permits higher temperatures and increased efficiency of dryers, dry kilns, blast heater, coil stacks, etc., by removing water condensation.

Does away with air binding in radiators, as the air is exhausted.

Eliminates all back pressure on engines supplying the exhaust.

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is the only grate from which you can get the maximum results when burning the cheapest kinds of fuel. Positively the Strongest Designed Shaking Bar in the market. It will allow your fuel to generate more steam than any other grate now manufactured. The "CYCLONE" Grate allows 68% of air space and 90% under draught. The "CYCLONE" is guaranteed never to warp and cannot get out of adjustment. Write for testimonials, and let the user convince you of its dependability and economy.

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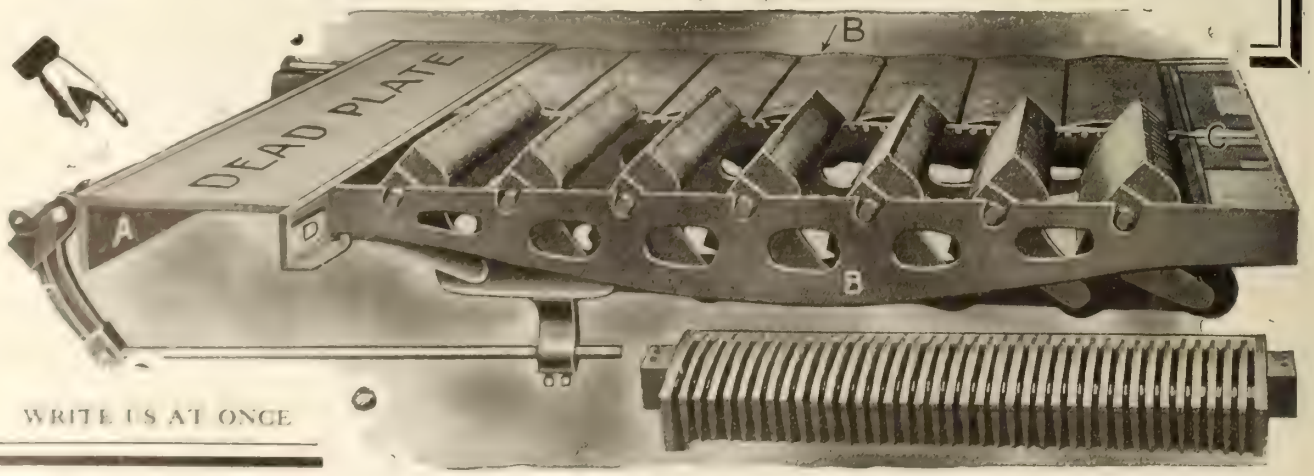
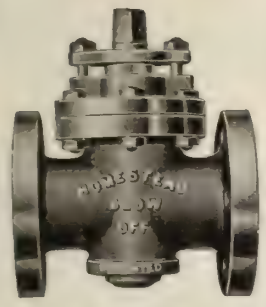


WRITE US AT ONCE

HOMESTEAD
STRAIGHTWAY VALVES

ALWAYS OUTLAST
OTHER VALVES



For Pressure Up to
5000 lbs. Per Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details.

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Homestead Valve Mfg. Co.

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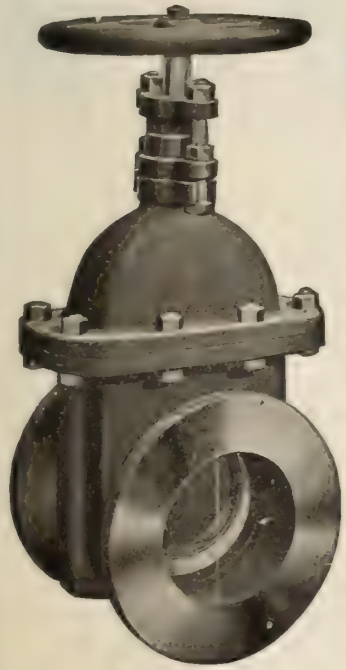

Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
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WALKERVILLE - ONTARIO

The Dart Union

THE bronze to bronze ground joint of the dart union avoids all trouble from corrosion—for non-corrosive metal forms each face of the joint.

THIS is only one feature. Those two bronze seats are combined with heavy iron parts that give strength to the union and prevent all stretching.

THEN there is a straightway through the dart union—no crooks or cored parts to weaken it or to hold water and collect sediment.

ALL threads are cut absolutely to standard.

A consistently constructed union—a union that has a record of fifteen years' success in exacting service—a union that you ought to thoroughly know.

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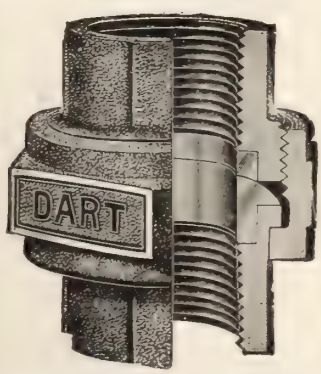

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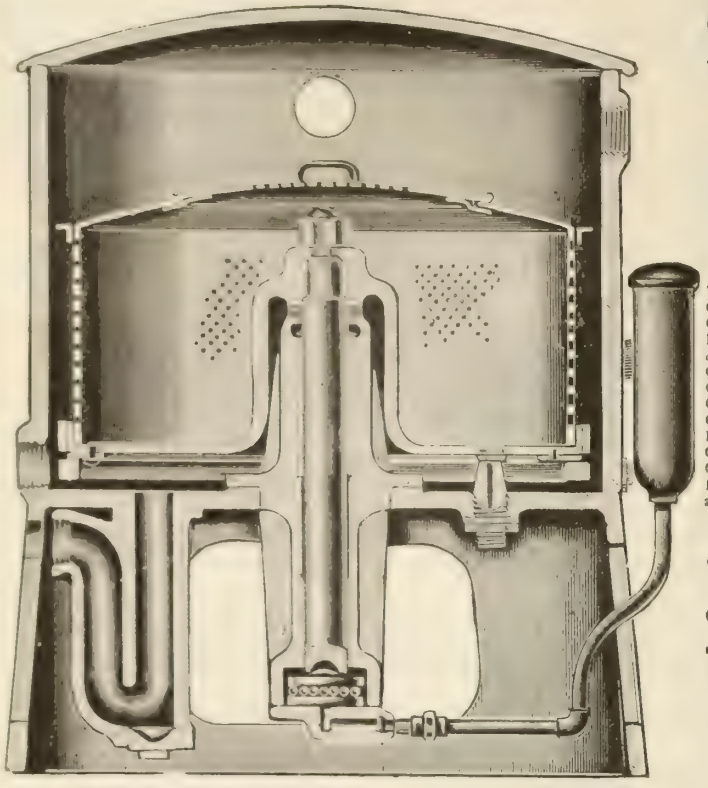

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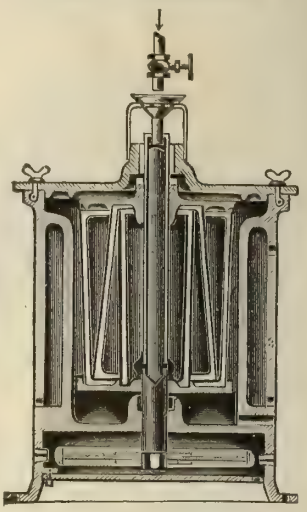

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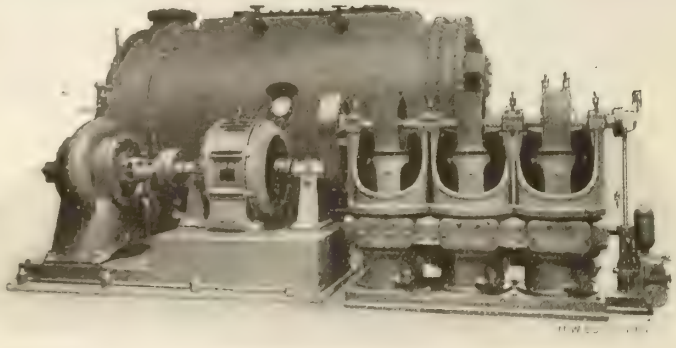

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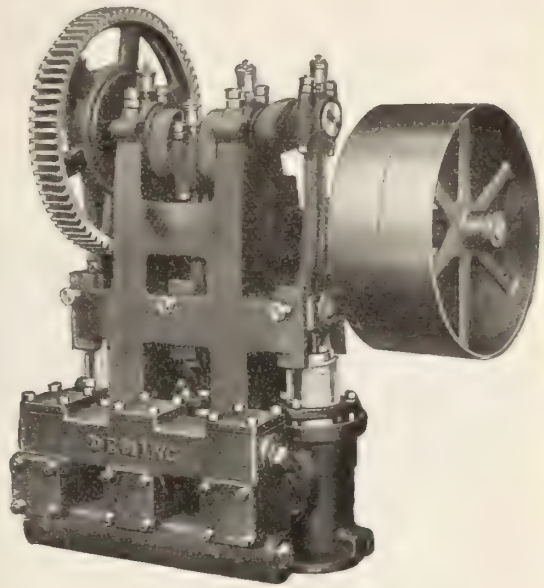

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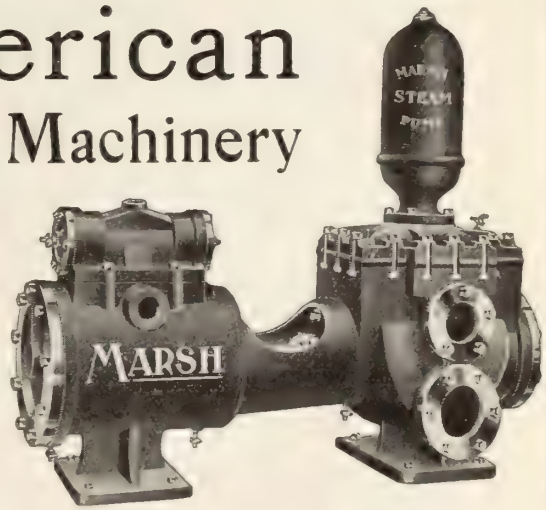

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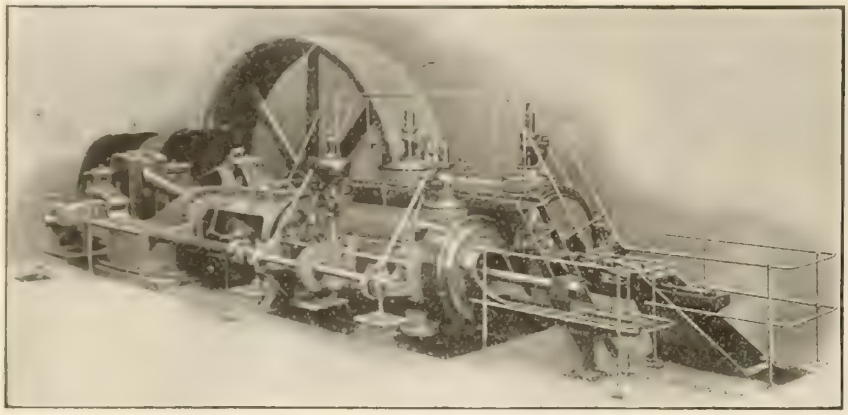

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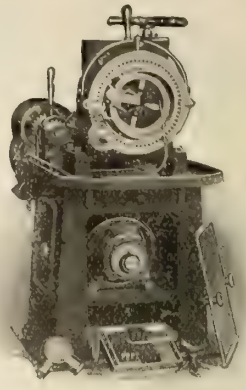

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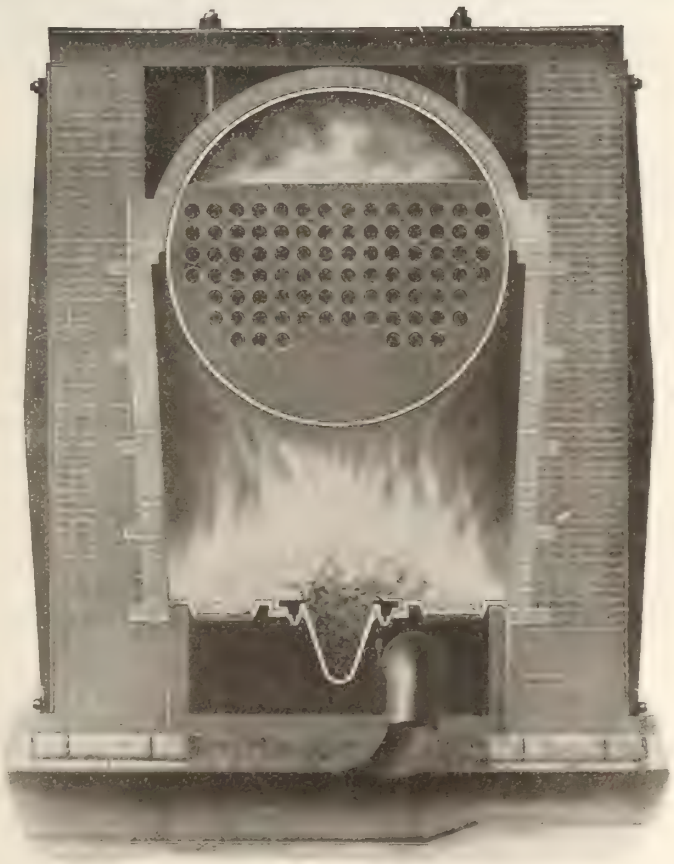

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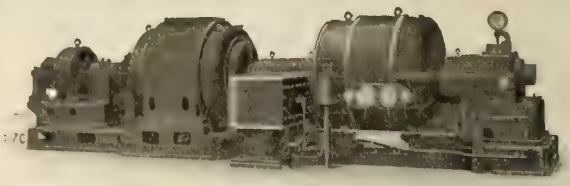

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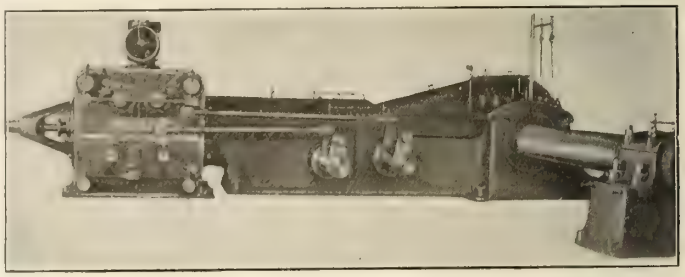

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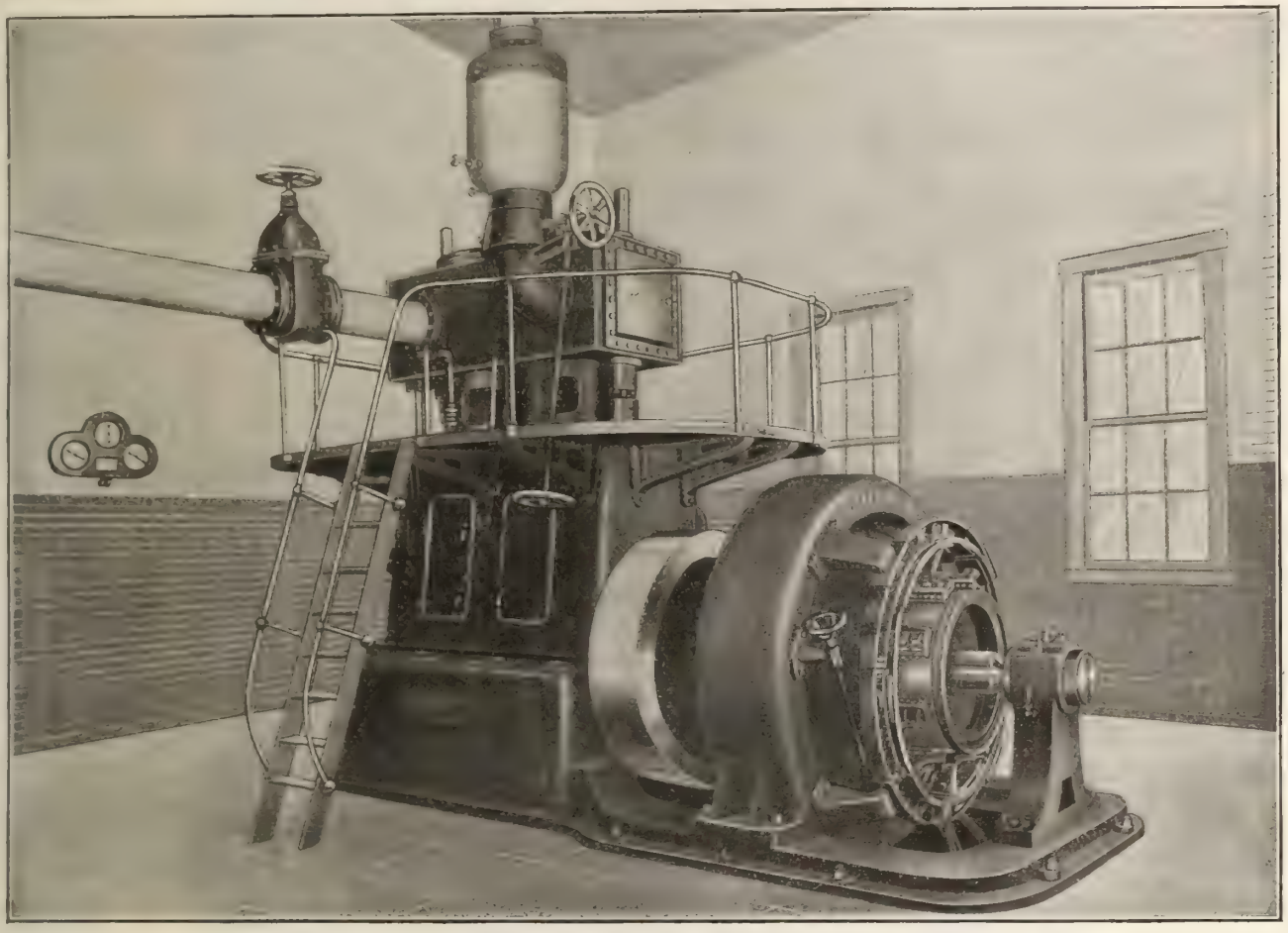

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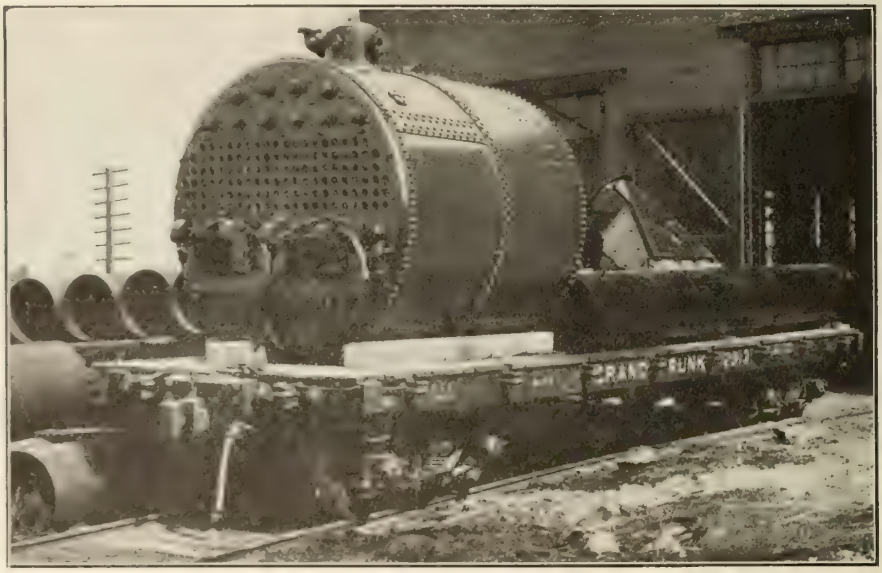

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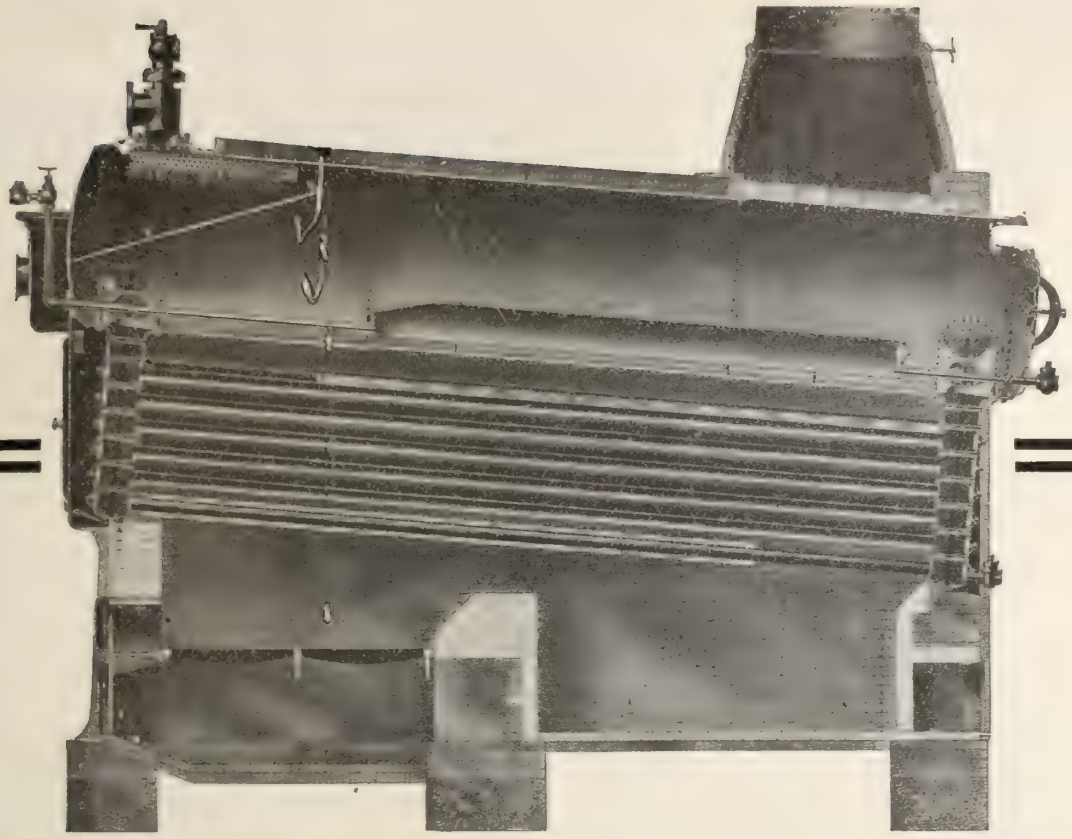

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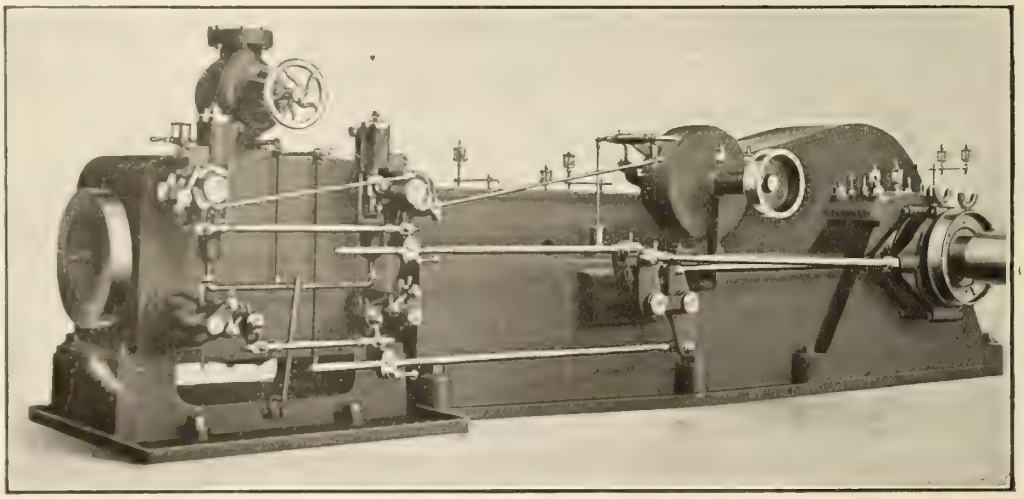

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History and Development of the Zoelly Steam Turbine *

By H. Zoelly, Zurich, Switzerland

The Steam Turbine, as a Developer of Power for Stationary and Marine Purposes, is Making Such Rapid Headway in the Supersession of the Reciprocating Steam Engine, That we Feel Every Opportunity Should be Embraced, Whereby Records of Construction and Operation of the Various Leading Types, be Placed at Our Readers' Disposal. The Zoelly Steam Turion and Subtraction.

BASED chiefly on experience gained with water turbines, the author, about 15 years ago, commenced to experiment with steam turbines, believing that the latter would in most features resemble the former, other than using a much higher working pressure. For this reason, he was guided to adopt the pure action or impulse type of steam-turbine. The unusual experience that his firm had obtained in respect not only of water-turbines, but also of ordinary reciprocating steam-engines during a period of

Fig. 1.—Guide Channels in Diaphragm Plate.

over seventy years, proved to be of very great assistance in carrying out the experiments.

Radial Flow Principle.

The first machine was designed on the radial-flow principle. Too much regard was paid, however, to practical constructive consideration, and too little to theory. The second machine was constructed on the same principle; the blades being curved in preference to the previously flat type. The steam impinged against the rotor blades in a radial direction. This construction constituted a considerable improvement upon the earlier design. At this stage, it was found advisable to divide the pressure drops into at least six, and sometimes ten to twelve separate pressure-stages. The diameters of the rotor wheels were also increased in size, towards the exhaust end, in order to cope better with the increased volume of the steam.

As already observed, the principle of the action (impulse) type has been recognized and adopted from the commencement as being the best; the only alterations that took place for some time being in the manner of guiding the steam on to the wheels. The first wheels were constructed like the Pelton wheel, against which the steam impinged tangentially, after being directed through separate guide-channels. It soon became apparent, however, that after impact, the steam became too much dispersed, therefore it was decided to expand the steam axially instead of radially. This was done at first only in the low-pressure stages, but subsequently, throughout the whole turbine. The same method had formerly been adopted by English constructors, as being the most practical.

Design of Runner Wheels and Guide Channels.

The most characteristic feature of the Zoelly turbine, is the designing of the runner-wheels and guide-channels in the diaphragms, Figs. 1 and 2; the former of which, in spite of the high factor of safety necessary, are enabled to be given a relatively high circumferential velocity. In consequence, greater latitude is permissible with regard to the number of pressure stages, and speed of the steam in each.

From the start, two very characteristic diagrams have been prepared, Figs. 7 and 8. These were obtained from theoretical calculations, which have since been proved by actual results. Fig. 7 contains as abscissae the pressure relation per stage $\frac{p1}{p2}$ (where p1=the initial steam pressure in atmospheres absolute, and p2=the final steam pressure in atmospheres absolute in the same stage), and as ordinates, the requisite number of stages for steam expanding from 10 atmospheres to 0.1 atmosphere (that is, 142 lb. per square inch to 1.42 lb. per square inch), assuming that the pressure ratio $\frac{p1}{p2}$ of the steam, both before and after passing through the guide-channels, is constant. Fig. 8 shows

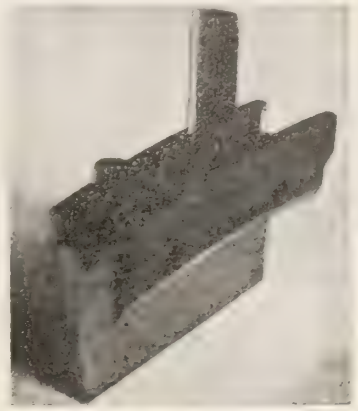


Fig. 2.—Method of Building up Runner Wheel

Fig. 3.—Section of Runner Wheel.

the steam velocity resulting from pressure ratios given for various initial pressures. For a ratio pressure fall of $\frac{p1}{p2}$=1.732, it follows from Fig. 7 that about nine stages are required. For relative pressure-falls where $\frac{p1}{p2}$ =1.1; 1.2; 1.3; 2.1; 3; 4.6, the requisite and corresponding number of stages for a total expansion of from 10 to 0.1 atmospheres absolute would be 42; 25; 18; 6; 4; and 3, respectively. Should we assume a greater ratio of pressure-fall than 1.732 for the purpose of saving stages, then, in order to have only four stages, it is necessary to have a ratio pressure-fall of $\frac{p1}{p2}$=3.

From Fig. 8 for a mean initial pressure of p1=4 atmospheres absolute, the steam velocity would be equal to 577 m. (1,893 feet) per second. This steam velocity, on the other hand, would require a circumferential speed of about

*Paper read at the Zurich, (Switzerland) meeting of the Institution of Mechanical Engineers. (England). July, 1911.

250 m. (820 feet) per second, that is, (for a simple velocity wheel) in order to obtain a reasonable efficiency. Again, if we take a smaller ratio of pressure-fall than $\frac{1.732}{1}$, for instance $\frac{1.30}{1}$, the necessary number of stages would be increased from 9 to 18, that is, exactly double. Such a turbine would be far too complicated and expensive; besides it would not work with perfect economy owing to the greater friction of the runner-wheels and the greater length of steam passage.

Fig. 4.—Stages in Manufacture of Nickel Steel Blades for Rotor.

After carefully weighing up all these considerations, the ratio pressure-fall of $\frac{91}{52}$=1.73 was chosen as representing the best combination of efficiency and practical constructional economy. This pressure-fall is called the "critical fall," and when this is exceeded, then the resulting steam velocity approaches the velocity of sound. Directly one wishes to utilize a substantially higher pressure-fall per stage, then it becomes necessary to depart from the simple construction of parallel guide-nozzles, peculiar to the Zoelly turbine, and adopt, instead, the expanding or "Laval" type of nozzle. The reason that Parsons employs such a small pressure-fall per stage, is wholly to keep down as low as possible, the losses through leakage which are unavoidable in reaction turbines.

General Description.

The writer will not deal further with the various stages of improvement since then, and which have been solely of a constructional character, but will describe the Zoelly turbine as manufactured at the present time. For turbines of 3,000 revolutions per minute, 8 stages are usually employed; for 1,500 revolutions per minute, 12 stages; and for 1,000 revolutions per minute, 16 stages.

The first diaphragm plate (guide-wheel) of the high-speed turbines has nozzles which extend for a portion of the circumference only, in the bottom half of the diaphragms; whilst in the other diaphragms, the nozzles usually extend completely round the circumference. In the case of large units, however, steam is admitted through channels extending completely round the circumference for all stages.

Fig. 5 and 6.—Die and Mold for Blade Channels, Showing Nickel Steel Blades in Position

Governing.

The governing is effected, simply by throttling the live steam and not by varying the number of channels through which the steam is admitted. The throttle-valve is actuated by oil under pressure in a small cylinder (servo-motor), the oil being supplied by a small pump directly driven from the shaft. It is the same form of governing as has been found to work so successfully for water-turbines, and being adopted by nearly all the different makers of steam-turbines on the continent. Its inherent advantages are, that it is extremely simple and reliable, and, contrary to fears expressed by some engineers, is particularly economically at partial loads, as is seen from the results shown later. This, however, is only possible when simple velocity wheels are used in connection with parallel guide-nozzles throughout the whole turbine, and provided that the most favorable choice is made in regard to the sub-division of stages. Fig. 9 illustrates a simple velocity stage in the Zoelly turbine, and shows section of blading. The conclu-

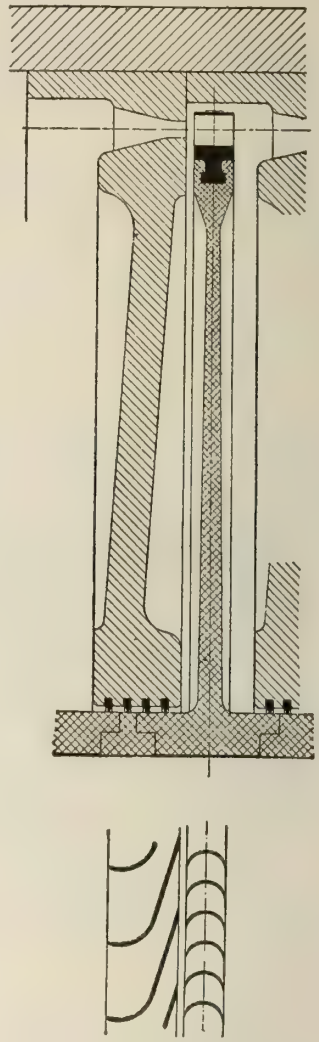


Fig. 9.—Single Stage of Zoelly Impulse Turbine and section of blading.

sion arrived at is that the compound velocity wheel design is only advisable in special cases, as, for instance, in shipbuilding, where a lower propeller speed is absolutely necessary. Fig. 10 illustrates a portion of compound velocity-wheel and section of blading.

The chief reasons against the adoption of the compound wheel design in the case of stationary turbines are, the lower steam efficiency and the necessity of a complicated governing apparatus, in order to obtain a favorable consumption at partial loads. In this type of turbine the governing has to be carried out by controlling the number of nozzles through which the steam enters. Experience has shown that this method does not satisfactorily answer practical requirements, i.e., continuous safe running. Besides, the governing is not so accurate and is less suitable for running in parallel with other machines.

High Steam Velocity and Compound Wheels.

The author would especially like to mention that for many years he has experimented with turbines designed with a high steam-velocity and compound wheels. The many series of tests which he has carried out at different periods have all gone to show that under the most favorable conditions it is not possible to obtain a higher thermal efficiency with compound velocity wheels than 58 per cent., whereas with a turbine designed with entirely simple velocity stages it is possible to obtain an efficiency of 73 per cent. and more. If, therefore, in an impulse turbine, it is found necessary to employ a combination design of compound and single velocity stages in such special cases as exceptionally large units for land purposes, or where it is necessary to work at low revolutions. The comparatively poor efficiency, of the high-pressure compound velocity stage or stages, must be compensated for as far as possible by obtaining a relatively higher efficiency in the subsequent low-pressure single velocity stages. For this purpose almost as many pressure stages must, on the whole, be provided, as in a design employing only single velocity stages.

It is often objected to in the Zoelly turbines that too high pressures and temperatures exist in the first pressure stage. Against this it must be said that even with Zoelly turbines equally large pressure-falls can be utilized for the first stage, even within comparatively economical limits, provided that the lower pressure or subsequent stages have a correspondingly lower pressure-fall and consequent higher efficiency. In this way it happens that by the application of live steam at about 170 lbs. per

Fig. 10—Section of Double-Velocity Wheel of Impulse Turbine and Section of Blading.

square inch and 570 deg. F. (300 deg. C.), the pressure and temperature of steam after expansion in the first stage is 70 lbs. per square inch and 465 deg. F. (240 deg. C.). Such conditions, as

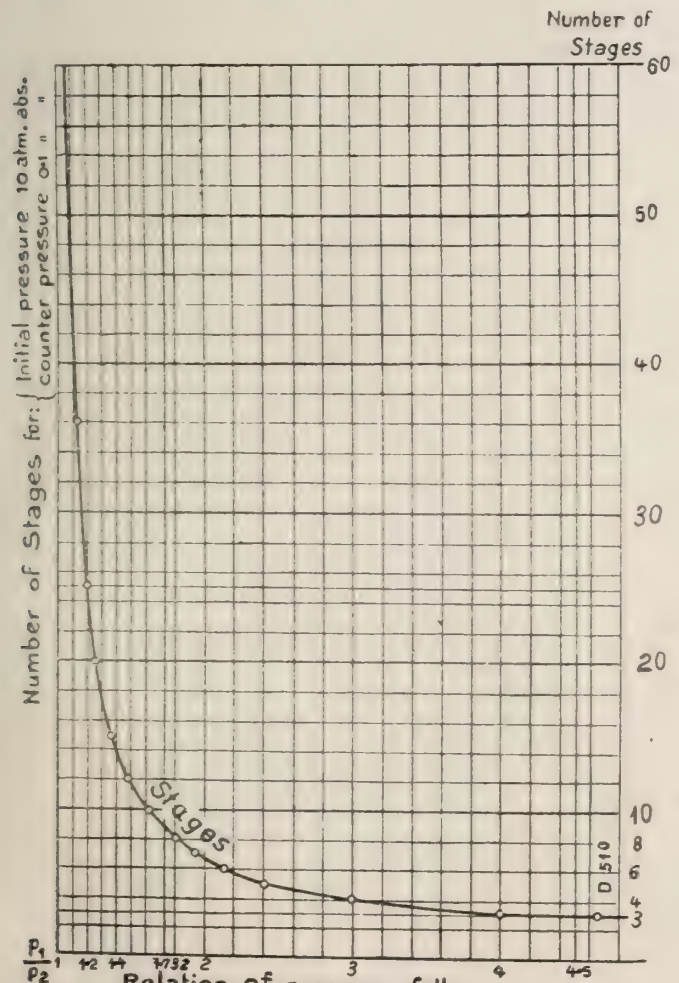


Fig. 7.—Curve showing number of stages required in expanding from 10 atmospheres to various final pressures.

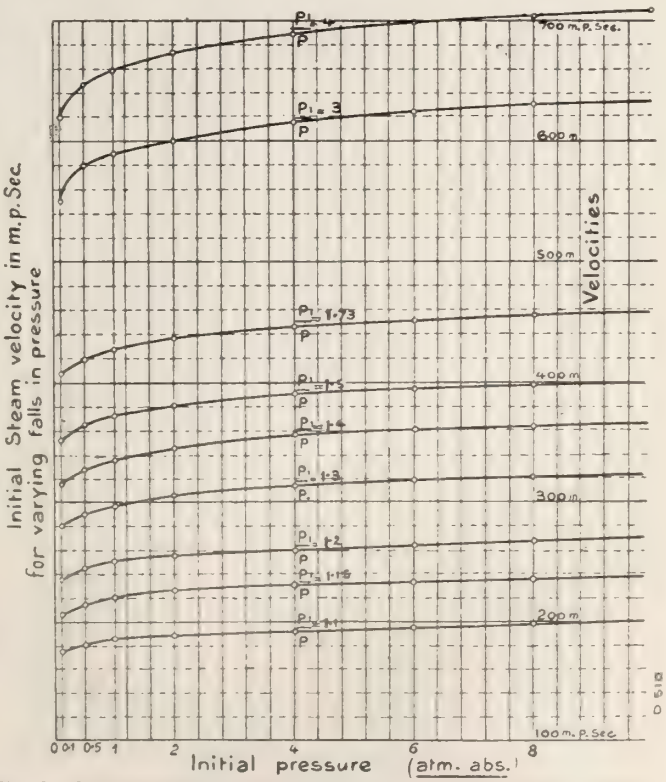


Fig. 8.—Curves showing steam velocities for varying initial pressures.

regards the solidity and durability of the casing and its stuffing-boxes, are nowadays easily mastered by steam-turbine builders.

Following these considerations, attention is now drawn to a few typical designs of turbines which have been con-

structed for various purposes. As the illustrations shown probably convey more to the mind of an engineer than a detailed explanation, only a short account of each design is given.

Construction of the Zoelly Steam Turbine.

The Zoelly turbine has from the commencement been constructed with a horizontal shaft, experience with water-turbines having shown that by this method the simplest form of bearing can be used, permitting easy inspection at all times. In the case of turbines running at 3,000 revolutions per minute a flexible shaft is used, so that the critical speed is sufficiently below the working speed; but in the case of turbines running at 1,500 revolutions per minute and under, the contrary is the case, the shaft is rigid and the critical speed is above the working speed. The shaft is supported by two bearings which are lubricated by oil under pressure, and is connected by means of a rigid or flexible coupling (usually rigid) to the generator or machine to be driven. The casing is built up in two halves, the joint being horizontal, so that the rotor can be easily inspected without dismantling the bearings. An idea of the accessibility of all the important parts can be gained from the illustrations shown.

Fig. 11, shows the rotor of turbine raised for inspection, and Fig. 12 shows oil-cooling apparatus.

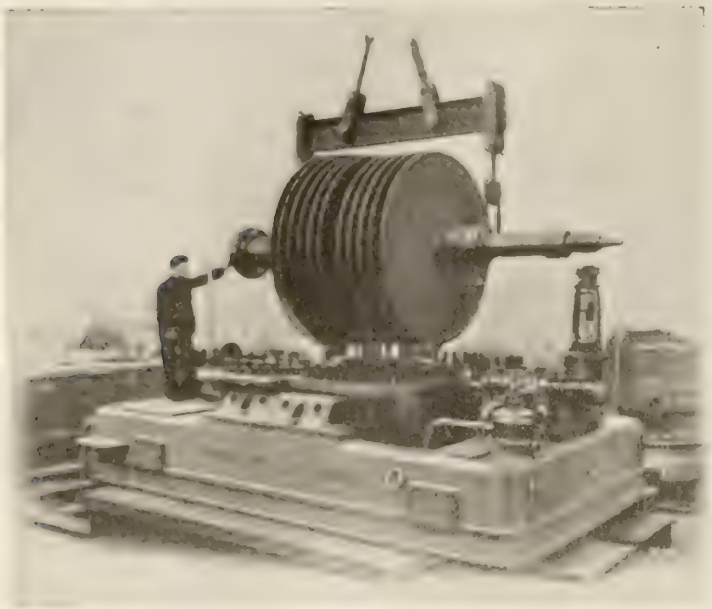


Fig. 11.—Rotor of Turbine raised for inspection purposes.

Fig. 12.—Oil Cooling Apparatus.

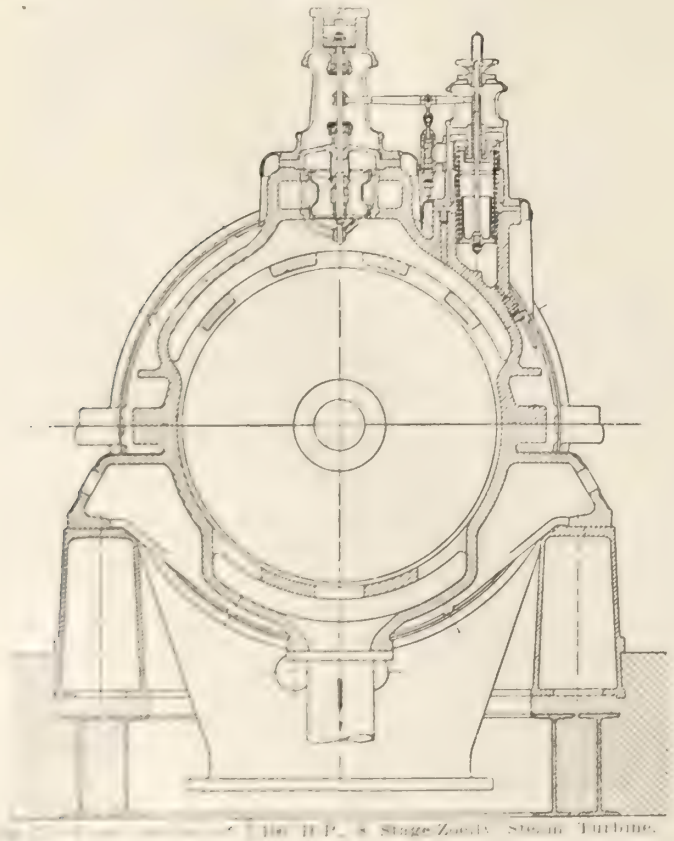


Fig. 18.—The H.P. 8 Stage Zoelly Steam Turbine.

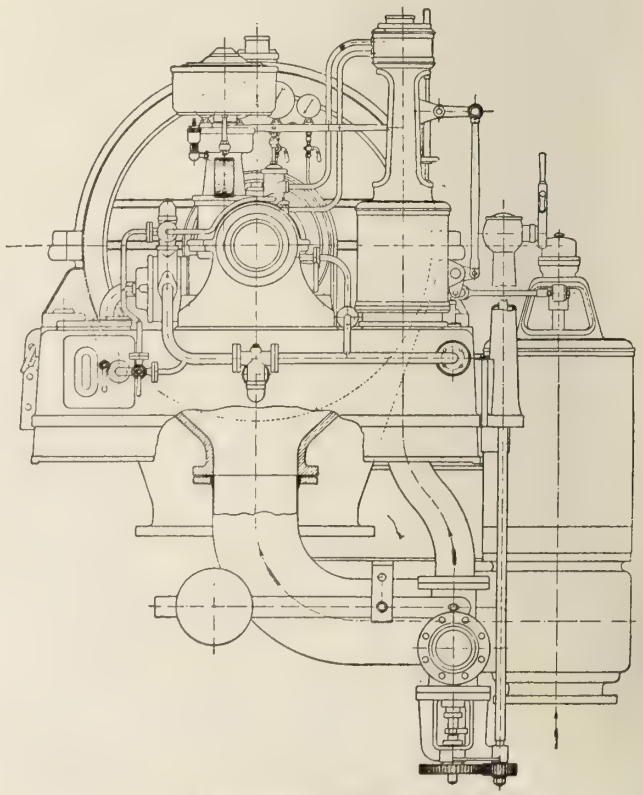
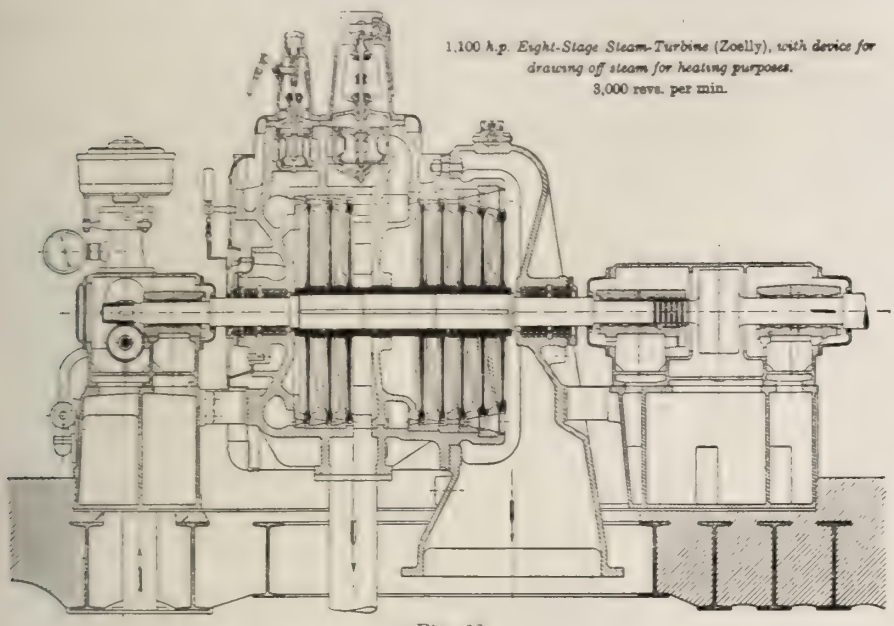


Fig. 19.—End Elevation of Turbine.

Test Results.

In connection with the foregoing description and illustrations showing the characteristic features of the Zoelly turbine, it will now be interesting to consider some actual results obtained on trials (see table). These results are not what may be called "parade-results"; on the contrary, they have been reported by means of specially tested instruments and by impartial officials. These figures show the high economy that is obtained by this turbine, particularly at partial loads. Fig. 13 shows to scale a section of a normal 8-stage Zoelly steam-turbine constructed to develop 1,500 to 1,800 h.p. at 3,000 revolutions per minute with a steam pressure of 170 lbs. per square inch at 570 deg. F. (300 deg. C.) and with a vacuum of 95 per cent. Fig. 14 shows to scale a section of a normal 12-stage Zoelly steam-turbine constructed to develop 3,000 to 5,000 h.p. at 1,500 revolutions per minute with a steam-pressure of 170 lbs. per square inch at 570 deg. F. and with a vacuum of 95 per cent.

Figs. 16 and 17 show to scale a section of an 8-stage Zoelly steam-turbine



1,100 h.p. Eight-Stage Steam-Turbine (Zoelly), with device for drawing off steam for heating purposes. 3,000 revs. per min.

Fig. 16.

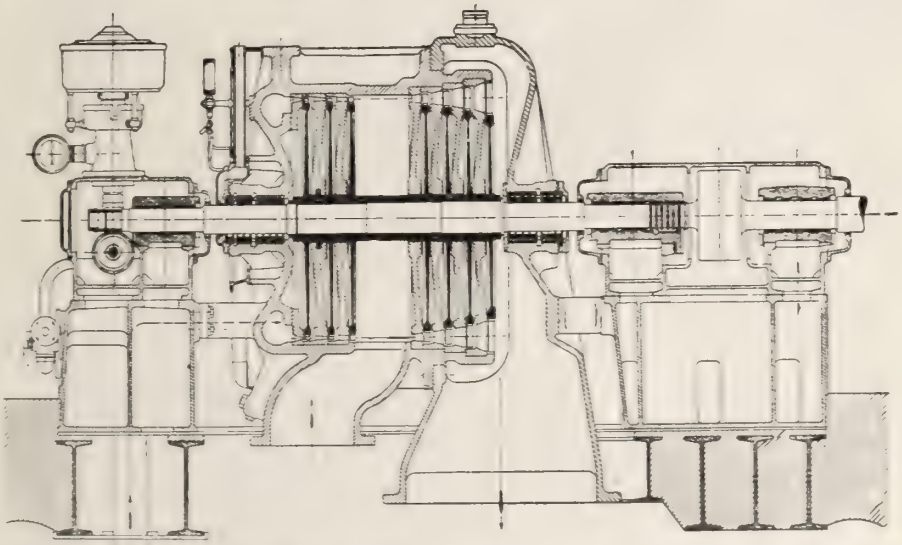


Fig. 18. 1,800 H.P. Mixed Pressure Zoelly Turbine, 3,000 r.p.m.

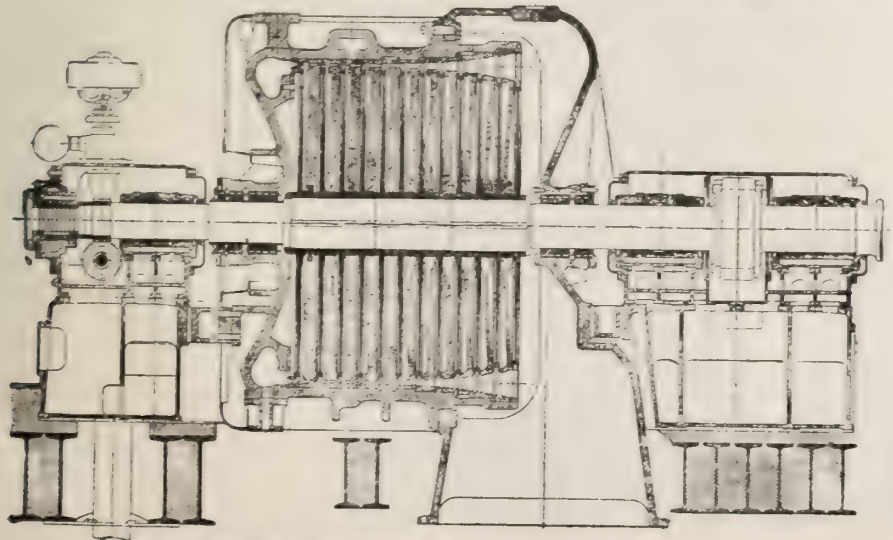


Fig. 14.—3,000-5,000 H.P. Twelve Stage Zoelly Steam Turbine. 1,500 r.p.m.

fitted with a connection for drawing off about 4,500 lbs. of steam per hour at a pressure of 3 to 5 lbs. per square inch for heating and other purposes. This turbine was constructed for the "Zurcher Papierfabrick, Sihl," to develop about 1,100 h.p. at 3,000 revolutions per minute with an initial steam-pressure of 115 to 120 lbs. per square inch at a temperature of 570 deg. F. and with a vacuum of 95 per cent. Figs. 18 and 19 show to scale a section of a mixed-pressure Zoelly steam-turbine constructed for "Zeche, Dannenbaum," and to develop 1,800 h.p. at 3,000 revolutions per minute with a main steam-pressure of 115 to 120 lbs. per square inch, using exhaust steam at a pressure varying from 5 lbs. to 12 lbs. per square inch and with a vacuum of 91 per cent.

Zoelly Marine Turbine.

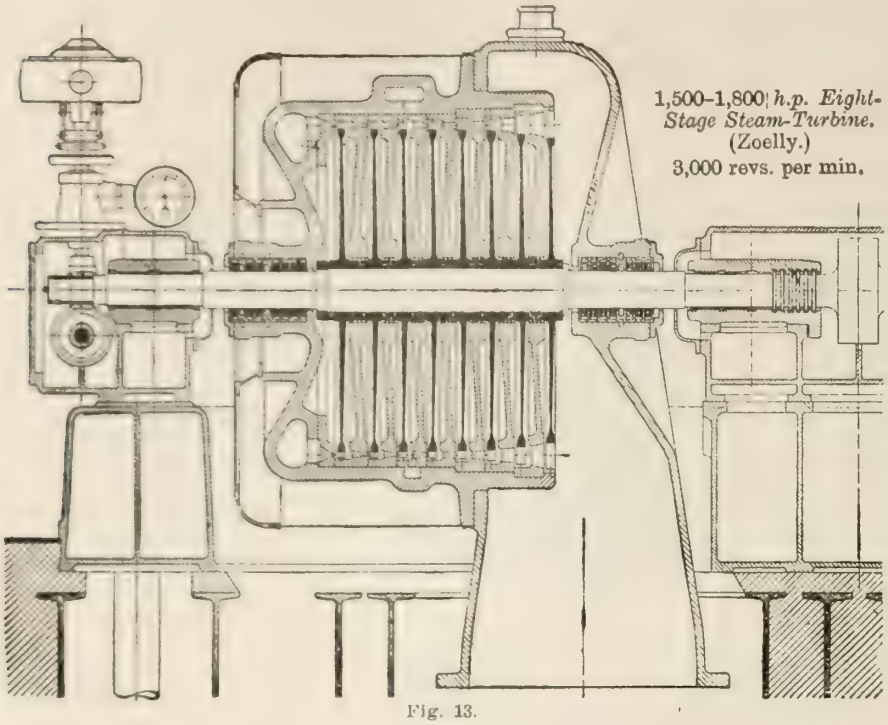
During the same period that the previously referred to experiments were being carried out, so also tests were also in hand, with a view to perfecting a design of slow-running turbine suitable for ship propulsion. The high-pressure portion of these marine turbines is fitted with a series of compound velocity wheels. Fig. 10 illustrates a portion of one of these wheels and a section of the blading. Owing to the number of revolutions being too low, single velocity wheels cannot be utilized to their full advantage. To obtain a reasonable efficiency with the single velocity wheel would allow of only a very small drop of pressure in each stage, and necessitate far too many stages.

Again, contrary to the theories put forward by Curtis, it was found advisable to adopt the ordinary parallel guide channels, similar to those used in the Zoelly land turbine, in preference to expanding or "Laval" nozzles—a type of construction which has since proved its merits. These turbines were contained

in two entirely independent casings, together with the astern expansions. Owing to the low number of revolutions obtainable in marine turbines, it would only be possible to use single velocity wheels if there were a great number of pressure stages, which is not practicable owing to the length required, and still more to the very high cost of construction of such a design. The high-pressure portion of these turbines therefore consisted of a series of compound wheels. The low-pressure portion consisting of impulse drum blading.

Messrs. Escher, Wyss & Co. recently built in their workshops at Zurich a set of two marine turbines, each of 7,500 h.p., which are now in operation in the torpedo-boat destroyer "G, 173" of the Imperial German navy.

Fig. 20 shows the rotor complete, and Fig. 21 the section of turbine. In accordance with similar constructional designs and calculations made by the builders, a number of similar marine turbines are now being constructed for the German, French, American, Italian and Argentine navies.



1,500–1,800 *h.p. Eight-Stage Steam-Turbine.* (Zoelly.) 3,000 revs. per min.

Fig. 13.

The Mallet articulated compound locomotives built during the present summer by the C.P.R. at their Montreal shops, are showing excellent results in service. They are stationed at Field, B.C., and work east from there to Stephen. Another will be turned out in October, differing from its predecessors, in being a simple engine with four high pressure cylinders, and making the sixth "Mallet" to be put into service by the company. Its performance will be watched with interest.

WATER POWERS SURVEY.

A survey of all the water powers of Canada by the conservation commission is in progress, and a report covering these resources in every province will be issued before the end of the year.

The commission's engineers have completed their work in the Maritime Provinces and Quebec, and are now in the West, bringing up-to-date, data of the water powers there. For Ontario, reliance is placed on the work of hydro-electric power commission. The conservation commission has been advised of an important change of policy on the part of the Quebec Government in respect to water powers. These latter will not hereafter be alienated in perpetuity, but for long terms subject to revision of rentals.

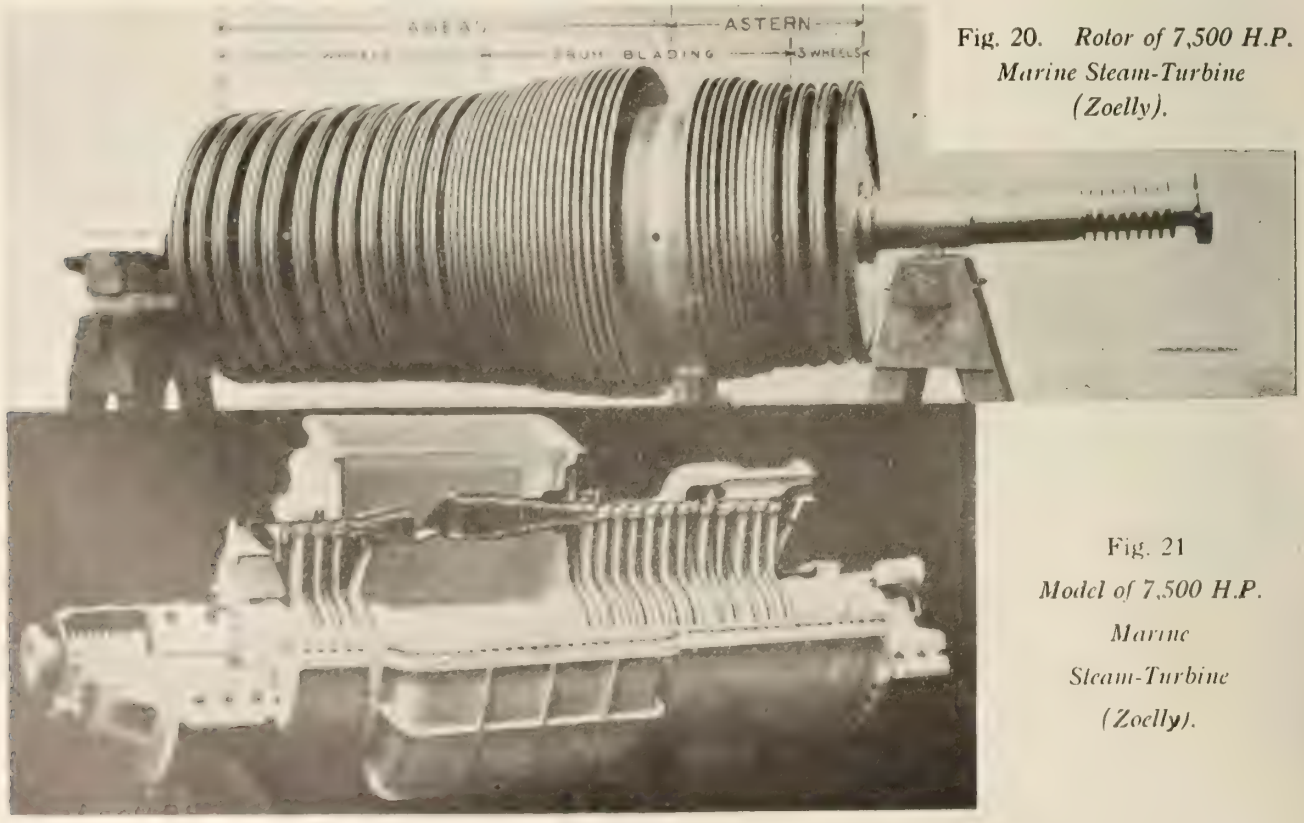


Fig. 20. *Rotor of 7,500 H.P. Marine Steam-Turbine (Zoelly).*

Fig. 21 *Model of 7,500 H.P. Marine Steam-Turbine (Zoelly).*

Feed Water Heaters*

By D. K. Dean**

ACCORDING to the pressure of steam used for the heating medium, feed water heaters in general are divided into three classes, live steam heaters or purifiers, atmospheric or exhaust steam heaters, vacuum or primary heaters.

Live Steam Heaters.

The live steam heater is used primarily as a purifier. It consists of an enclosing steel shell, containing pans, over which the water flows. Steam under boiler pressure, is admitted directly into the enclosing shell, and comes in contact with the water which it heats to the temperature of live steam. When water containing impurities, such as carbonates or sulphates of magnesium or calcium, is heated to a temperature exceeding 300 deg., these impurities are to a very large extent, precipitated, if the water be kept at the high temperature sufficient long for such action to take place. As a consequence, the live steam purifier has considerable value in regions where bad feed water only is to be had. Ordinarily, the commercial type of live steam purifier does not allow sufficient storage space for full precipitation of the impurities to be accomplished. However, for the smaller size plants, in which the cost of a special chemical purifying apparatus would be too great, this type of purifier can accomplish the elimination of a sufficient amount of scale impurities to make its installation profitable.

As a heater, the live steam purifier offers virtually no economy, steam being taken directly from the boiler and returned again to it. In a few cases where the circulation of the water in the boiler is sluggish, some saving may be made on account of increased boiler efficiency made possible by higher velocity of the convection currents flowing across the heating surface, due to the introduction of feed water at a higher temperature. As a general proposition however, no heating economy is to be expected by the use of a live steam purifier.

Exhaust Steam Heater.

1. The pre-heating of boiler feed water, by means of the heat in exhaust steam, otherwise wasted, makes possible a saving of about 1 per cent. in the total heat consumption of the plant, for every 11 deg. the temperature is raised. The percentage of saving is of course, dependent upon the initial temperature of the feed water, and the presure at which the boilers are operating.

2. Also if cold water be introduced into a boiler containing a body of water at a high temperature, those parts which are touched by the cold water will be subjected to shrinkage strains, causing leakage or damage to the boiler. The pre-heating of the feed water would lessen the posibility of these shrinkage strains becoming excessive and injurious.

3. When water containing impurities, such as calcium and magnesium carbonates is heated to a tempreature of 200 deg. or more, the carbon dioxide which holds these impurities in suspension, is driven off and they become insoluble, and precipitate either entirely or partially, according to the time the water is kept hot. By pre-heating feed water containing impurities, and allowing it to remain in storage for some time before being introduced into the boiler, the latter may be protected from an accumulation of scale which otherwise would form on the tubes.

For one or all of these reasons, the exhaust steam feed water heater is a necessary adjunct of almost every power plant. The various requirements to be met in different locations have of course given rise to the development of several different types, and oftentimes the results of an extensive engineering experience are necessary to choose the most suitable for any given case. In general, exhaust steam feed water heaters are of two types, the open and the closed.

Open Type Exhaust Steam Heater.

In the open type of heater, the steam is introduced directly into a chamber in which the water to be heated is sprayed, or allowed to run in thin films over pans. The steam comes directly in contact with the water, the part necessary to do the required heating being condensed, and becoming a part of the feed water. Because the steam used for heating purposes is usually the exhaust from boiler feed pumps and other auxiliary units in which large quantities of lubricating oil must be used, an efficient oil separator is necessarily a part of every open heater, and it is chiefly upon the effectiveness with which this accesory removes the oil present that the proper operation of the heater depends.

After passing through the heating system, the water falls into a storage space at the bottom of the heater, from which it is removed by the feed pump and delivered to the boiler. In many types of open heater, the lower part of the storage chamber is filled with coke, or some filtering material, the purpose of which is to remove insoluble impurities from the water which passes through it. The admission of the feed water to an open heater is accomplished by some means independent of the action of the feed pump. A ball float on the water in the storage at the bottom of the heater, opens the feed water inlet valve, and admits the water as the level in storage falls. As the level rises, the valve is closed and the supply is shut off.

Because of the fact, that the water in an open heater occupies a part of the exhaust chamber of the engine, there must be supplied an overflow to prevent the feed water from backing up through the exhaust pipe and into the cylinder of the engine. The discharge from this overflow should be connected through an independent trap. In some types, this overflow is connected directly with the trap, in which the oil from the separator is collected. This introduces an

Installation.	Load in kw.	Steam pressure at stop-valve. Lb. per sq. in.	Steam pressure at stop-valve. Temp. ° F.	Vacuum.	Steam consumption. Kw.-hour.	Steam consumption. H.p.-hour.	Thermal efficiency per cent. Based on condition of steam in front of stop-valve.	Thermal efficiency per cent. Based on condition of steam behind stop-valve.
				Per cent.	Lb	Lb.	Per cent.	Per cent.
4,000 kw. turbine	4189	164.7	556.7	95.8	*13.25	9.36	68.7	71.2
"Charlottenburg"	3092	168.3	558.3	96.2	13.77	9.58	66.2	70.8
1,000 r.p.m.	2199	161.9	518.5	97.4	14.40	9.84	63.2	70.75
Tested Dec., 1910	1138	166.9	520.7	97.8	16.00	10.12	59.9	72.7
2,000 kw. turbine	2052	179.0	584.6	94.9	13.04	9.18	70.5	73.0
"Helsingfors"	1514	181.7	563.3	95.5	13.67	9.52	67.2	72.8
3,000 r.p.m.	1026	177.5	565.5	95.8	14.53	9.76	65.2	73.8
Tested Nov., 1910	510	171.8	543.0	96.6	17.33	10.68	58.8	72.8
1,700 kw. turbine	1691	206.0	670.2	93.3	13.04	8.91	69.7	69.8
"Hagendingen"	1366	202.3	673.5	94.2	13.77	9.18	66.5	69.2
3,000 r.p.m	851	205.2	662.0	95.2	15.52	9.81	61.0	66.9
Tested Dec., 1910	457.5	208.0	642.9	94.9	18.91	10.68	57.1	67.9
1,200 kw. turbine	...	...	...	...	...	...	...	...
"Aurich"	1235	162.3	451.0	94.0	15.34	10.77	67.0	68.3
3,000 r.p.m	949	164.0	442.4	95.5	15.99	11.08	62.8	66.9
Tested, Dec., 1910	606	166.7	427.4	96.5	17.1	11.48	59.0	66.6

* Not including steam required for condensing plant.

TABLE OF TEST RESULTS. THE ZOELLY STEAM TURBINE.

*Paper read at the C.A.S.E. Convention, Stratford, Ont., July, 1911.

**Of the Alberger Condenser Co., New York.

element of danger since the water may enter the trap through the overflow. If the trap should fail to operate, this would cause all of the oil which has collected for a considerable period, to rise into the body of the heater and be delivered from there into the boiler.

Closed Type, Exhaust Steam Heater.

In the closed type of heater, the steam and water to be heated are separated by the walls of the brass or copper tubes. The steam never comes in contact with the water to be heated. There is, therefore no danger of the feed water becoming contaminated with oil. The closed heater is usually placed between the feed pump and the boiler, and consequently must be designed to withstand the boiler pressure.

The effectiveness of a closed heater in accomplishing a given result, is dependent largely upon the velocity of the water across the heating surface. The breaking up of the body of water into small streams, also tends to increase the effectiveness of the heating surface since the individual particles of water can be brought more intimately in contact. It has been determined, that the rate of heat absorption by a stream of water from the heated wall of an enclosing tube of small diameter, is proportional to the square root of the velocity of the stream across the surface. It follows then, that the higher the velocity of the water in contact with a heater tube, the greater will be the rate of heat absorption per unit of surface; and within the limits of practicality, that design of heater which permits the attainment of the highest water velocities, is the most efficient.

Choosing a Heater

In the closed as well as the open type, all does not depend upon the effectiveness with which the body of water is broken up into small streams. The condition of the steam itself is of great importance. If the body of heating steam contains air in any appreciable quantity, the temperature of the mixture of the water, vapor and air, will be that in the steam tables corresponding to the partial pressure of this water vapor. [illegible], the difference between the temperature of a mixture of air, steam and water in the heater, is much less than if air-free steam alone should occupy the space. There is however, a [illegible] why the pressure of air in a heater will lower the efficiency. [illegible] and gives up its heat at a much lower rate than does saturated steam, which, when heat is abstracted from it, condenses and intimately covers or associates itself with the cooling medium. Reliable tests have indicated that a partial pressure of air amounting to 1-8 inch will reduce the heat transmission 25 per cent.; a partial pressure of 1-4 in. will reduce it 40 per cent.; and a 3-8 in. partial pressure will reduce the heat transfer 50 per cent.

These facts indicate the importance of choosing a design of heater, in which there is but little chance for air-binding. They show also, the lowered efficiency to be expected, if sufficient attention is not paid to piping the heater in such manner as to reduce the possibility of air-lodging to a minimum.

Types of Closed Heater.

In general, closed heaters are of two types, the steam tube and water tube. In the former steam passes through the tubes, and the water around them, while in the latter, water passes through the tubes, and the steam surrounds them in the body of the shell. Of these two types of closed heaters, the latter has practically supplanted the former, because of its greater efficiency.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

It is but seldom that a steam tube type of heater is preferable, being in those cases only where storage of hot water is required for use at intermittent intervals, and in such quantities that there would not be sufficient steam to heat it to the desired temperature.

The water-tube type of heater is more efficient because the body of the water is broken up into small parts, and further, the various particles of water are brought more intimately in contact with the heating surface when passing through tubes, than if allowed to take their sluggish course through the comparatively large shell area of the other. A second reason is that the heating surface is less likely to be fouled by condensation and air present in steam.

In the steam tube type, the full boiler pressure is in the large containing shell, while in the water tube type, the small diameter tubes or the well supported water spaces are only subjected to high pressures. Again the shell of the steam tube heater being of large diameter, must be made of steel. This is more subject to the corrosive action of the heated water than cast iron, which is ordinarily used as the material of construction of a water tube heater. Because of the sluggish flow of the water in a steam tube heater, if scaling impurities which are set free at the temperature of the feed water be present, they are sure to collect at the hottest point, that is, on the heating surface. In some heaters of the water tube type, the water may be directed across the surface at such velocity, or in such manner, that all scaling impurities set free are washed from the heating surface into water chambers provided for their settlement.

Closed heaters are of the large coil, the small coil, the U tube, the straight smooth tube and the straight corrugated tube type, depending upon the kind of tubing used for the heating surface. With the steam tube heater, there is but little difference in the efficiency of any of these types, the chief difference arising from structural considerations. With the water tube types, results vary and the following outline and description applies to these latter.

The Large Coil Type.

In this type, the water is made to pass through tubes coiled on a large diameter, and fastened rigidly to manifolds at the inlet and outlet. Since the diameter of the coil is large, the diameter of the tubing must also be large, in order that it may be stiff enough to prevent undue chattering. Hence, the rate of heat transmission is much lower than would be the case if the water were required to pass through tubing of smaller diameter. This type is not desirable in locations where the feed water is bad, since it is practically impossible to clean the heating surface if it ever becomes fouled.

The Small Coil Type.

With this heater the coils are of small diameter, consequently the tubing may be small diameter also. Here, the velocity of the water may be quite high, ensuring good heat transmission, and tending to prevent the formation of scale. For bad water conditions, however, this type is not as suitable as a straight tube heater.

The U Tube Heater.

In this type, the tubing consists of U bends, the water being made to pass through several series of these, thereby securing a fairly high velocity.

(See October Issue for Continuation.)

The Montreal Technical School, Its Mission and Equipment

By L. G. Dennison, B.A., B.Sc., Montreal

The Rapid Growth and Development in Canada of Mechanical and Electrical Engineering Pursuits, and the Desire to Excel in These Competitively With Other and Older Countries, has Called Forth the Necessity for Facilities and Opportunities, By Which the Practical Work of the Factory may be Turned to Better Account Through a Judicious Admixture of Technical Training Technical Schools are in Project by all the Leading Manufacturing Centres of our Country, and That of Montreal Which Forms the Subject of this Article, is Among the First of its Kind to be Completed and Open for the Reception of Students.

THE lack of an efficient technical training institution has been keenly felt for some considerable time in Montreal, and while efforts have been put forth on various occasions to deal satisfactorily and successfully with the question, only recently did these assume that definite shape, the culmination of which has been the building and equipment of a Technical School, costing approximately $825,000.00, and creditable to Canada's Metropolitan City.

Foundation and Buildings.

Founded, built, equipped and annually subsidised by the Provincial Government of Quebec, and in receipt of a large yearly grant from the City of Montreal, this school is intended to provide adequate and complete instruction in manual trades generally, from the theoretical and technical standpoint, at moderate fees, to day and evening students. Its location is 70 Sherbrooke Street West, and the birds-eye view, fig. 1, gives a good idea of the lay-out and ground covered. The buildings are arranged in two distinct sections: the main structure being on Sherbrooke Street, and the workshop in the rear. The ground measurement is 153,000 square feet.

Main Building and Organization.

The main building which is wholly fireproof, comprises the following. The offices of the Adminstration, several suites used for teaching, including six class rooms, two amphitheatres with seating capacity of 100 each; physical and mechanical laboratory, chemical laboratory, store rooms for materials, museum of industries, library, etc. In the centre there is a large graded semi-circular amphitheatre with seating capacity for 600.

The different sections of the main building offer ideal conditions from the standpoint of comfort and hygiene. The class rooms are large, and equipped to secure complete satisfaction with respect to light, ventilation and heating. A commodious waiting room, toilet rooms, shower baths, and appropriate furniture throughout, conspire to impress one that expense and effort has not been spared to provide a thoroughly up-to-date establishment for its particular purpose. It is proposed to aug-

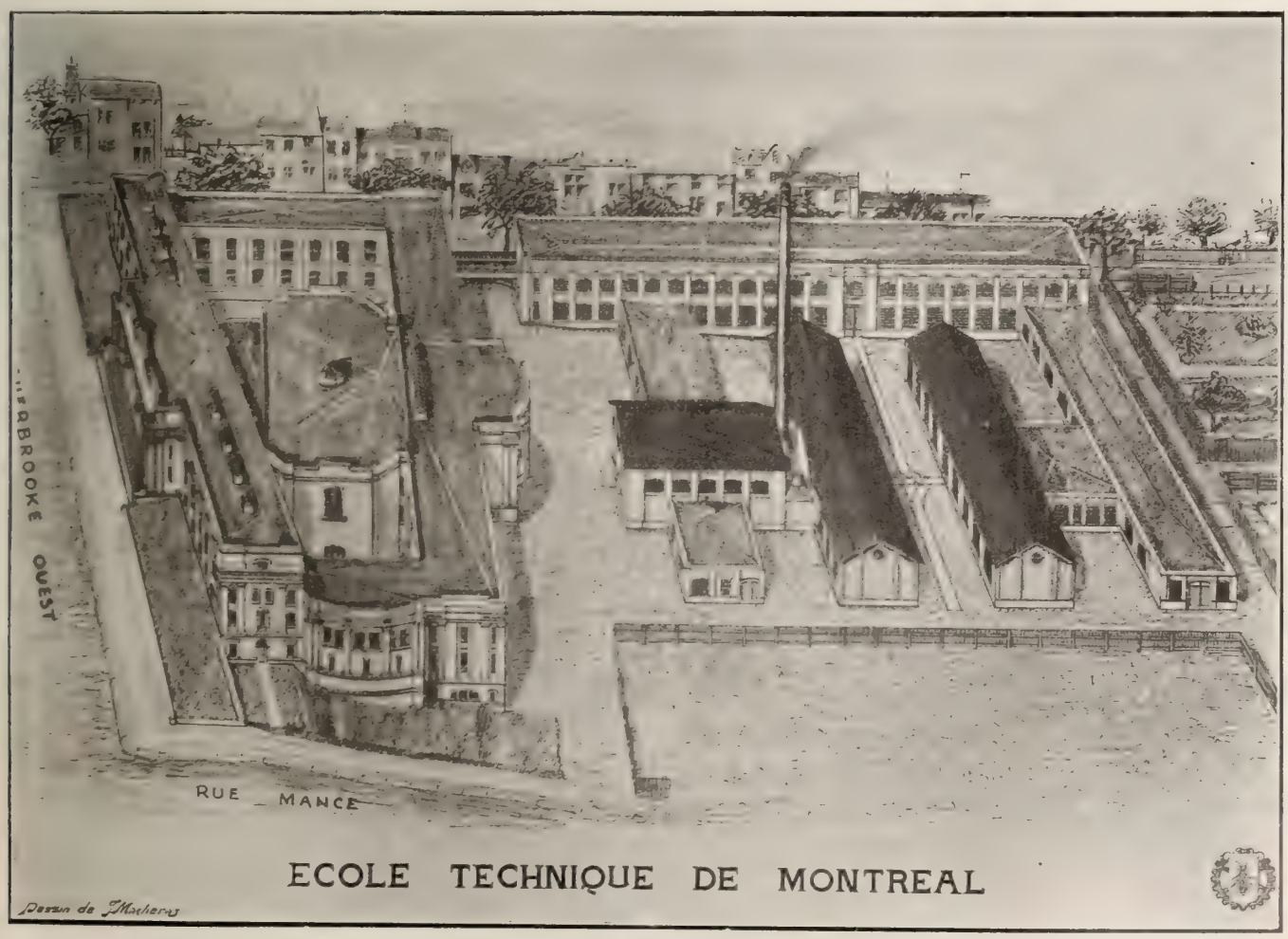
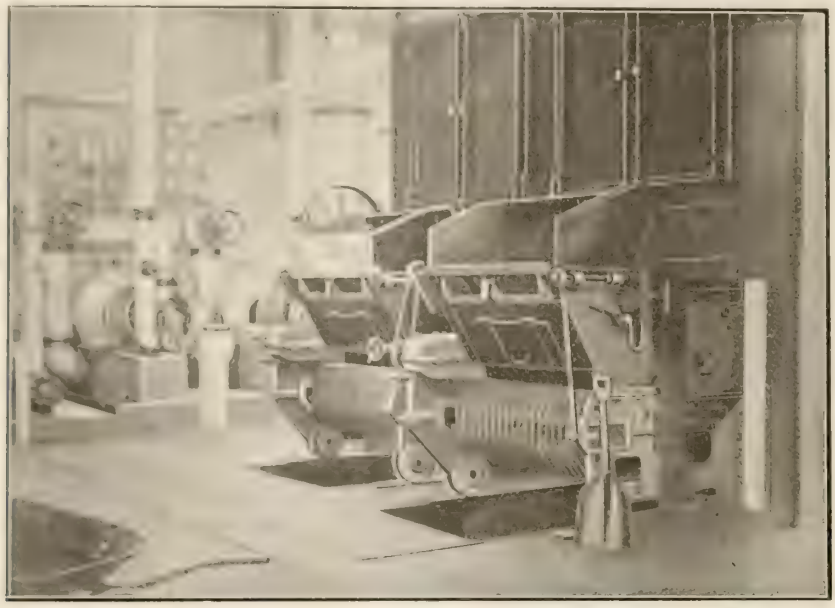


FIG. 1.—BIRDS-EYE VIEW, MONTREAL TECHNICAL SCHOOL.

ment the equipment and teaching apparatus by directing the work of the students accordingly, during each school course. Instruction will be given in both languages, French and English.

Work Shops and Power Plant.

The workshops are laid out on similar lines to those of modern industrial concerns; in the centre is the power house, and around are the foundry, machine shop, smith shop and electrical laboratory.



The Power House—Montreal Technical School.

The boiler room equipment consists of two Babcock and Wilcox boilers and one Delaunay-Belleville marine type boiler. The B. & W. boilers have chain grates, operated by a Miller Bros. & Toms engine. The heating apparatus for all the buildings is installed in the boiler room.

In the engine room are installed four electrical groups with direct connection, as follows:

1—One of 25 K.W., consisting of a gas motor Duplex, with Canadian General Electric dynamo;

2—One of 35 K.W., consisting of a Robb-Armstrong horizontal steam engine, with Canadian Crocker-Wheeler dynamo;

3—One compound vertical Bellis-Morcom engine, connected to a 75 K.W. Westinghouse dynamo;

4—One Goldie-McCullough Corliss engine, connected to a 125 K.W. Allis-Chalmers-Bullock dynamo.

An air compressor for the foundry, a storage battery with capacity of 200 ampere-hours, and switchboard for the control of the light and power, also form part of the engine room equipment.

The Switchboard.

In keeping with the high quality and finish of the various units, is the switchboard fig. 2, built and designed by the Hill Electric Switch & Manufacturing Company, Montreal. It consists of two feeders, one accumulator, and three generator panels of polished white Italian marble, which furnish a most attractive background for the highly finished copper fittings. The feeder panel, from which radiate the various power circuits, contains a Bristol watt-hour meter for recording total station output, and three double pole plain overload Condit circuit breakers. The lighting feeders are controlled by knife switches, with enclosed fuses on the face of the board. The accumulator panel has besides the meters, an underload breaker, a battery rheostat, and an eleven point end cell switch. The generator panels are equipped with Weston flush-type ammeters, of range 150 per cent. of generator output; and have three pole knife switches with ruses on the rear of the board. The voltmeter, fig. 3 on a swinging arm at the extreme left, can be made to indicate either the bus bar voltage, the voltage of any machine, or the drop of potential between bus bars and ground. The marble slabs, 7 feet high and two inches thick, rest on the floor thirty inches from the wall.

Machine Shop.

The machine shop has an area of 11,340 square feet, and contains the following machines, grouped in three sections, each driven by a 15 H.P. motor. Ten plain lathes of 10 inches, twelve screw cutting lathes of different makes from 12 inches to 18 inches, one Pratt & Whitney tool-room lathe; one geared-head Hendey lathe; three screw machines, one of which is automatic; four shapers, two planers; one seven-inch slotting machine; eleven drills from ten to twenty inches; one Brown &

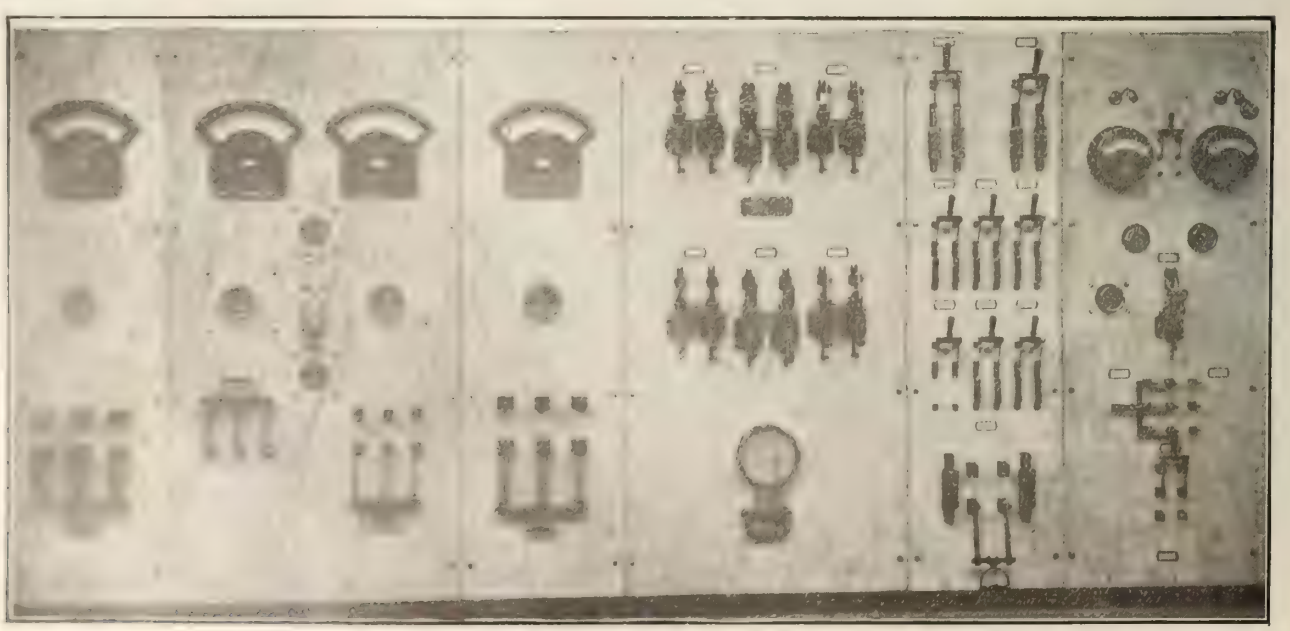


Fig. 2—Switchboard by the Hill Electric Switch Co., at the Montreal Technical School.

Sharpe universal milling machine; one plane and one vertical milling machine; one profile milling machine; one pentagraph milling machine; one universal grinding machine; one gear cutter; five tool grinders; one buffer; two centering machines; two mandril presses and a two ton portable crane.

The Machine Shop—Montreal Technical School.

In addition to the above, there are the following large machines, each driven by its own electric motor; six screw cutting lathes with attachments, one thirty-inch vertical lathe, one chucking lathe, one three foot radial drill, one horizontal boring mill and one floor planer. The space reserved for erecting is served by a three ton traveling crane. The tool store contains a full line of hand tools, measuring and tracing instruments, such as usually used in the best shops, also two Stewart combination gas furnaces..

Eighty vises, and 160 sets of individual tools complete the installation.

Forge.

The forge has an area of 5,210 square feet, and comprises twenty-four Sturtevant forges, twenty-four anvils, and one Buffalo Heating Furnace. The draft is underground and is produced by a 9 H.P. electric fan, while a 4 H.P. electric motor provides the necessary blast.

The other equipment consists of a steam hammer of 170 pounds, one belt driven hammer of 75 pounds, an emery tool grinder, a bar shear, a post drill, two swedge blocks, two blacksmith vises and one tool bench and vise.

Foundry.

The foundry has an area of 5,210 square feet, and is provided with one King cupola of two tons capacity per hour, one oil melting furnace, a Piat combined cupola and a 200 pound crucible furnace. This section is served by a trolley of two tons capacity. An underground installation of compressed air provides for the working of the elevator and other pneumatic tools and machines.

Other foundry equipment consists of two molding presses, one core machine, one coning machine, two core ovens, one sand sifter, one sand mill, one sand mixer, two snagging wheels, one torch heater and molder's benches for twenty-four pupils.

Wood-Working Shop.

The area of the woodworking shop is 6,811 square feet, and the machinery includes eight power wood lathes, four electric driven lathes of variable speed, one electric band saw, one circular saw, one gig saw, one buzz planer, one pony planer, one mortising machine, one tenoning machine, one drill, one shaper, two grindstones, one trimmer, one automatic band saw filing and setting machine, one knife grinder and one band saw brazer. There are thirty benches, with two separate sets of small tools each.

Electrical Section.

The electrical shop, covering an area of 2,714 square feet, adjoins the machine shop, thereby allowing use to be made of the latter as required. The following machines are installed:

One armature banding and heading machine, one notching press, one shear one pair of smoothing rolls and one buffer.

Annexed is an electro-dynamics laboratory, containing the following five groups of rotary transformers:

1—One single-phase asynchrone motor coupled to a direct current dynamo.

2—One direct current motor coupled to a three phase generator.

3—One series dynamo with shunt dynamo.

4—One six-change commutator.

5—One direct current motor coupled to an alternator giving single-phase, two-phase, or three-phase current, as desired, and the switchboard already described, which provides for electrical connections and measurements, as desired for experimental purposes.

Heating and Ventilating Systems.

The system of heating adopted, is that known as "Forced Hot Water Circulation," and is designed to be operated in connection with a high pressure power plant, utilizing exhaust steam from engines, pumps, and other apparatus. The heating medium, hot water, is circulated from the power house through the different buildings, by steam driven turbine pumps. The installation comprises two large heating tanks, one for exhaust, and the other for live steam; so arranged that when the amount of

The Blacksmith Shop—Montreal Technical School.

exhaust steam available for heating is insufficient to maintain the desired temperature in the buildings, an automatic valve opens, and allows the water of circulation to pass through the live steam heater before being forced through the buildings.

The particular features of this arrangement, consist in utilizing every pound of exhaust steam before live steam is requisitioned, and the consequent absence of back pressure on the engines. During many weeks of operation under severe conditions last winter, the temperature of water returning to the power house was less than ten degrees below the out-going temperature, and several occasions dropped only two degrees

The Foundry—Montreal Technical School.

The buildings are ventilated by means of large ventilating fans and steam tempering coils, the temperature of the whole being regulated by the Powers System of Automatic Temperature Control. Thirty cubic feet of fresh air per minute per pupil is supplied and exhausted in all class rooms, and liberal ventilation given in the work shops. Another interesting feature of the mechanical equipment, is the vacuum cleaning outfit provided for all portions of the main Academic Building.

The heating, ventilating, vacuum cleaning, and major portion of the electrical equipment were designed and supervised by Huey & Bellanger, consulting engineers, since incorporated under the name of the Canadian Domestic Engineering Company, Limited, 5 Beaver Hall Square, Montreal.

The material and cuts for this article, were furnished by the courtesy of the school management, the consulting engineers and the [illegible] contractors.

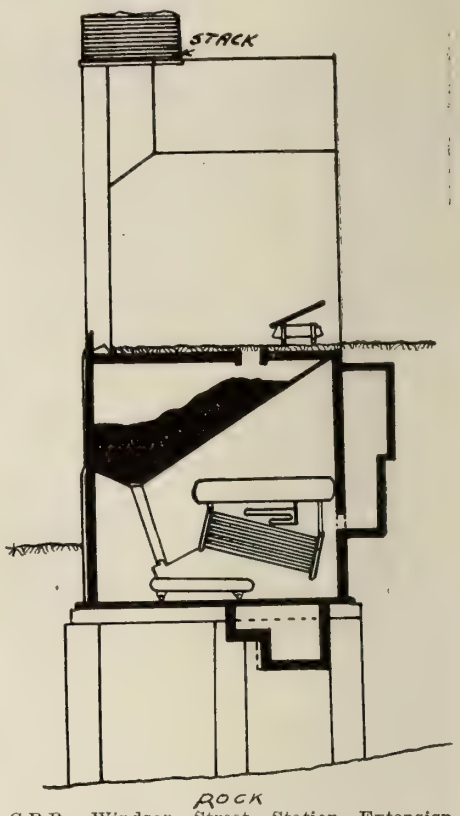
NEW POWER PLANT.

C. P. R. Windsor Street Station, Montreal.

The C.P.R. are installing a plant to heat the enlarged Windsor Street Station, Montreal. The coal handling facilities are of considerable interest, and the accompanying sketch of a section through the boiler room, gives some idea of the main features. The coal cars enter the pent house by a siding on the boiler room roof, and dump into concrete hoppers, from which the coal goes to the stokers in the usual manner. Ashes are taken to the hoist in flat cars, and from thence to the ash hopper, which discharges directly into cars on a siding.

The building is designed for the installation of 6-400 h.p. Babcock & Wilcox boilers, equipped with chain grates, although only three boilers are meantime called for. Solid re-enforced concrete is the constructional feature of the boiler room and pent house. These stand on twenty-four concrete caissons, six feet diameter, resting on bed rock. Live steam is used for heating purposes, and a tunnel 300 feet long built of concrete, carries the steam piping, etc.

The stack is 179 feet high, the lower eighty-nine feet of concrete, and the remainder of buff brick. The interior diameter is ten feet, with a two inch air space. Byers & Anglin, Montreal, are the contractors, and their supervising engineers are C. Harrington and J. H. Norris.



C.P.R. Windsor Street Station Extension, Montreal. Section through Boiler Room and Pent House.

Statistics show that the percentage of boiler explosions are less than that of fly-wheels, and the average loss ratio on fly-wheels more than twice the average loss ratio on steam boilers. A boiler explosion makes lots of noise and a fly-wheel goes to pieces without very much disturbance. A column will be given to the boiler accidents in the newspbper, but a few inches will generally serve for the fly-wheel accidents.

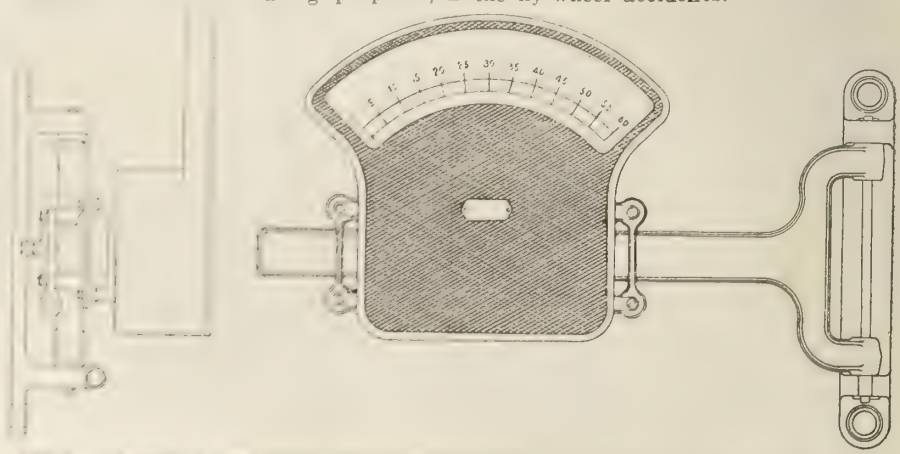


Fig 3.—Swinging Arm Voltmeter on Switchboard—Montreal Technical School.

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A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV SEPTEMBER, 1911 No. 9

SELF IMPROVEMENT.

BEFORE another issue of The Power House comes into the readers' hands, the season during which opportunity is given for self-improvement will have again come around. We are desirious of helping in this work, and in addition to further developing the general featured articles, purpose, with the co-operation of our readers, increasing the scope of that section devoted to "Practical Articles."

It needs to be pointed out that contributions to this department are not expected to be of extraordinary importance. To many, perhaps, some or all of the ideas that appear from time to time, are more or less familiar daily practice. While this is so, it should be realized that to the majority of our readers, there is much that is absolutely new, and for which they look greedily, we might say each month. It is therefore desired, that engineers in charge of large well-equipped power stations, should disburse the knowledge, and relate the experiences on which depend more or less complicated units under their care and control, and that those responsible for like results in small and medium sized plants, should tell of their achievements, in avoiding shut-downs, and averting disasters despite paucity of stand-by equipment through dint of high grade ingenuity and dogged, dare-devil determination not to be beaten.

Reciprocity is in the air; as a matter of fact, it is all-pervading just at the moment, and while its adoption by Canada and the United States may or may not be a boon to either or both, there is no question as to its value between employes working in variously equipped plants. The Power House reaches the whole field, and provides the barter ground on which experiences and ideas are traded; therefore we suggest, as a truly instructive and educative programme, that our readers set themselves ploddingly and enthusiastically to the task of contributing periodically, brief articles covering the daily problems of the plant, and the means employed to solve and overcome them. Time thus spent, will be found profitable and remunerative, in addition to being educative in the direction that cultivates alertness and prompt decisive action when emergencies arise.

1911 CANADIAN NATIONAL EXHIBITION.

THE Canadian National Exhibition at Toronto has once more come and gone, and judged from a general standpoint, it has again been an unqualified success. That each section which goes to make the whole, was given all the place and prominence it ought, we are not inclined to admit, and while doubtless there will always be kickers, with and without reason, the fact remains that power equipment and accessories as a feature of the Machinery Hall, were not as largely in evidence numerically as the progress of this Dominion warrants. We are constrained to believe that the poor accommodation afforded, has much to do with the absence of those whose products should be on show and who, so to speak are responsible with those exhibiting for much of the success of the whole undertaking, although indirectly.

Among a fairly long list of suggested additions and improvements for the next and succeeding Exhibitions, published in one of our newspaper dailies, we failed to notice any reference to the Machinery Hall. It is therefore apparent that their author must have been something out of the common among men; because if one thing is becoming more universally appropriated by and made to constitute a part of the very existence of men of every class, creed, trade and profession than another, it is the fascination engendered by machinery, majestic at rest, and mighty in motion.

The Machinery Hall was filled to overflowing with high class exhibits, yet as has been said only a small proportion of those who should be there, were of necessity accommodated. Public interest was sufficiently evident as to be continually jostled to attempt to satisfy its requirements, a circumstance which goes to show that the "Midway" does not provide all the attraction.

We unhesitatingly affirm, that due regard is not being paid to the requirements of those whose product belongs to this section, and while report has it, that a remedy will be provided by increased and more specialized accommodation in another year, no time should be lost in giving absolute confirmation, if such be the intention, and in getting details into shape. Machinery and power plant manufacturers, we know, desire this opportunity of displaying their product, but for the most part are handicapped by the want of a setting through which it will be given justice. Modern factory design and layout is in many cases infinitely superior for the display of the finished machine than the present exhibition hall, therefore, it is only natural that much material is withheld on that account.

Machinery enters so largely into the opening up of our country and interests so large a proportion of its population that no valid excuse exists for its longer occupying so insignificant a department in Canada's National and annual exhibition.

Commercial Limit of Superheat

By W. J. A. London.*

THE introduction of superheaters into practically all modern power plants is sufficient evidence of the unquestionable saving in coal that they accomplish. In many old plants it was found that by using only slight degrees of superheat, say 10 to 20 degrees Fah.—the saving was quite apparent, and curves showed it to vary almost directly proportional to the amount of superheat used. On trying this out in practice, beyond the figures mentioned, all manner of difficulties were met with, due to the detrimental effects of high temperature on the old-fashioned pipe joints, engine valves, etc., in use. The saving that could undoubtedly be accomplished by 100 degrees or more was of sufficient importance, however, to warrant the necessity of the engine builder and power plant designer to do something to meet these new conditions.

Superheat and the Steam Turbines.

The introduction of the turbine established a solution to main engine troubles. A careful study of materials most suited to the work has practically eliminated all pipe joint and valve troubles, and with the small turbine for driving auxiliaries in place of the slide valve engine, which is more or less troublesome under superheat, it may be safely said that the mechanical difficulties of superheat now to be encountered in a well-designed plant are negligible. Actual tests on steam turbines show a gain in steam consumption of about 10 per cent. per 100 degrees F., 18 per cent. per 200 degrees F., and so on, therefore a guaranteed water rate of 20 lbs. with saturated steam can be made to appear 15 or 16 lbs. with sufficient superheat. This looks well on paper, and often makes a big impression on a prospective customer, who may be foolish enough to consider that saving in steam means a direct saving in coal.

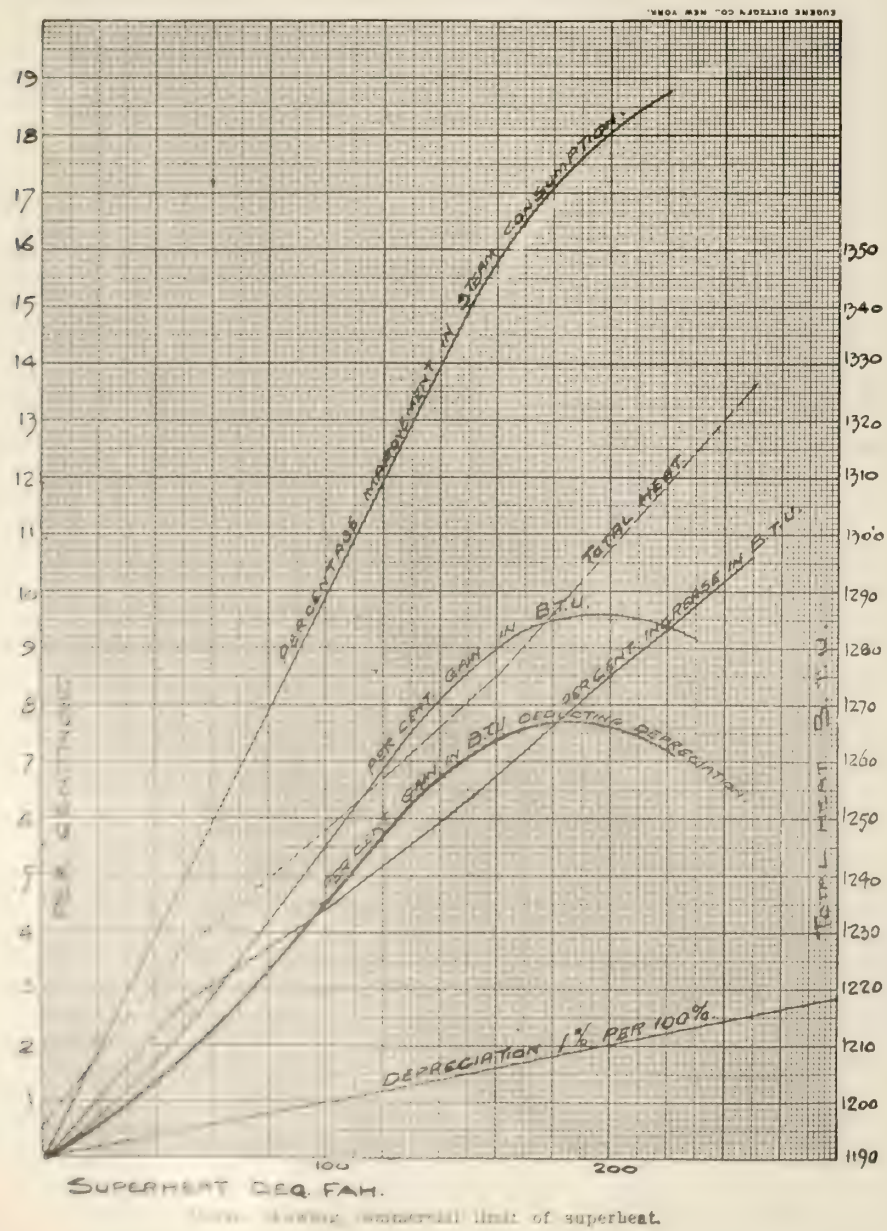
Commercial Considerations.

The curve produced herewith was plotted by the writer some years ago, during his investigation of the question as to how far it was commercially practicable to superheat. It shows, perhaps, more clearly than in any other form the fallacy of over-superheating. This curve was brought to memory by the publication of Capt. Car's paper before the American Soc. Naval Engineers on "American Practice in Using Superheated Steam"—and was published for the first time in a discussion on same, verifying absolutely Capt. Car's conclusions that little gain is to be accomplished over 150 degrees F.

Referring to the curve, the percentage gain in steam consumption from an actual turbine test are first plotted, then the total heat, and finally, the percentage increase in B.T.U. required to obtain any degree of superheat. Deducting this latter curve from the gain in steam consumption at the turbine, we get a curve which reaches a maximum at 200 degrees F., although the gain in steam consumption is still going up.

In a superheated steam plant, the depreciation is obviously greater than if saturated steam were used. The extent of this additional depreciation is at best a guess, but a discussion on the question with several engineers led the writer to use 1 per cent. for each 100 degrees. Deducting this from the percentage gain in B.T.U., we get the maximum point down to 180 degrees F. When it is borne in mind that the average flue gas temperature enables us to get 20 or 30 degrees of superheat without apparent increase in the coal pile, the final figure in actual practice will therefore be nearer 150 than 180 degrees. In other words, confirming the opinion of many experienced engineers, it is actually a direct loss to superheat beyond this point.

* Chief Engineer, the Terry Steam Turbine Co. Hartford, Conn.



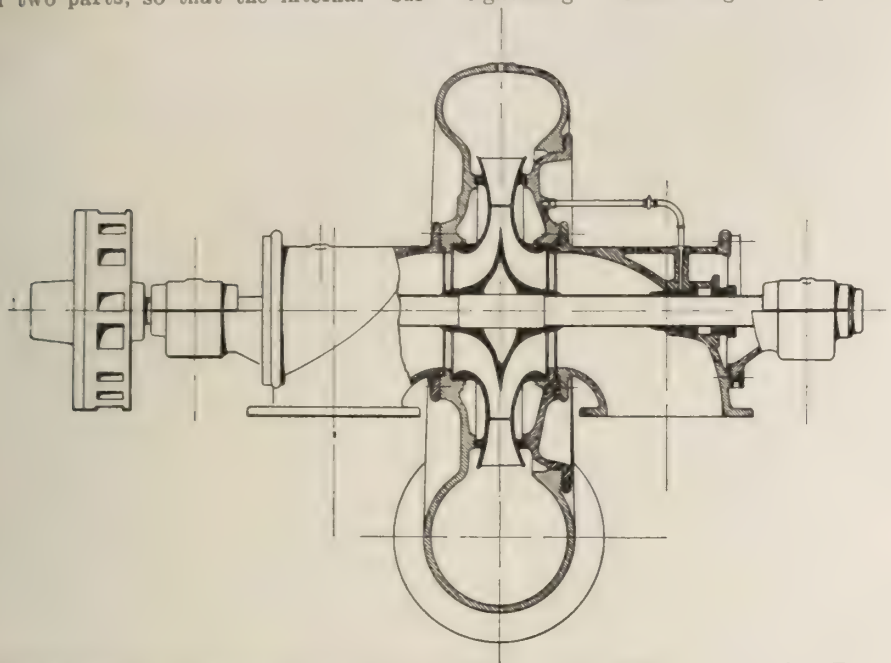
Curve showing commercial limit of superheat.

HIGH AND LOW PRESSURE CENTRIFUGAL PUMP.

THE accompanying designs of high and low pressure pumps, were created to develop machines which would be able to combine the most economical working, with solid and substantial construction, for heavy constant service. In order to comply with this first demand each machine is specially made to comply exactly with its particular individual requirements, and every part worked out in detail; all surfaces exposed to the flow of the high speed water, being dressed, machined or smoothed carefully to avoid loss due to friction.

Constructional Detail.

Impellers are, as a rule, manufactured in two parts, so that the internal surfaces may be smoothed or machined; the two parts being riveted together by means of copper rivets. The guide wheels or guide discs are, generally made of two pieces, and like the impeller parts, are attached to each other by copper rivets also. The passage of the water from one runner to the next is accomplished, so that no abrupt change of speed occurs, and consequently the friction loss is kept as low as possible. The whole design of the pump is substantial, and no material has been spared, consistent with the requirements of experience. The internal parts in touch with high speed water, are either covered with, or manufactured wholly of a special bronze alloy. The shaft is also covered by bronze in order to avoid wear or tear. At places where a moving part of the pump has to be drawn up against stationary parts, special tightening bronze rings are provided, which may, in case of need, be easily replaced. The bearings, of ample size, of ring lubricating pattern, and split on the horizontal plane, are provided with removable bearing bushes, covered inside with babbitt metal.



Single Stage, Low Pressure, Double Suction Turbine Pump.—Escher, Wyss Co., Toronto.

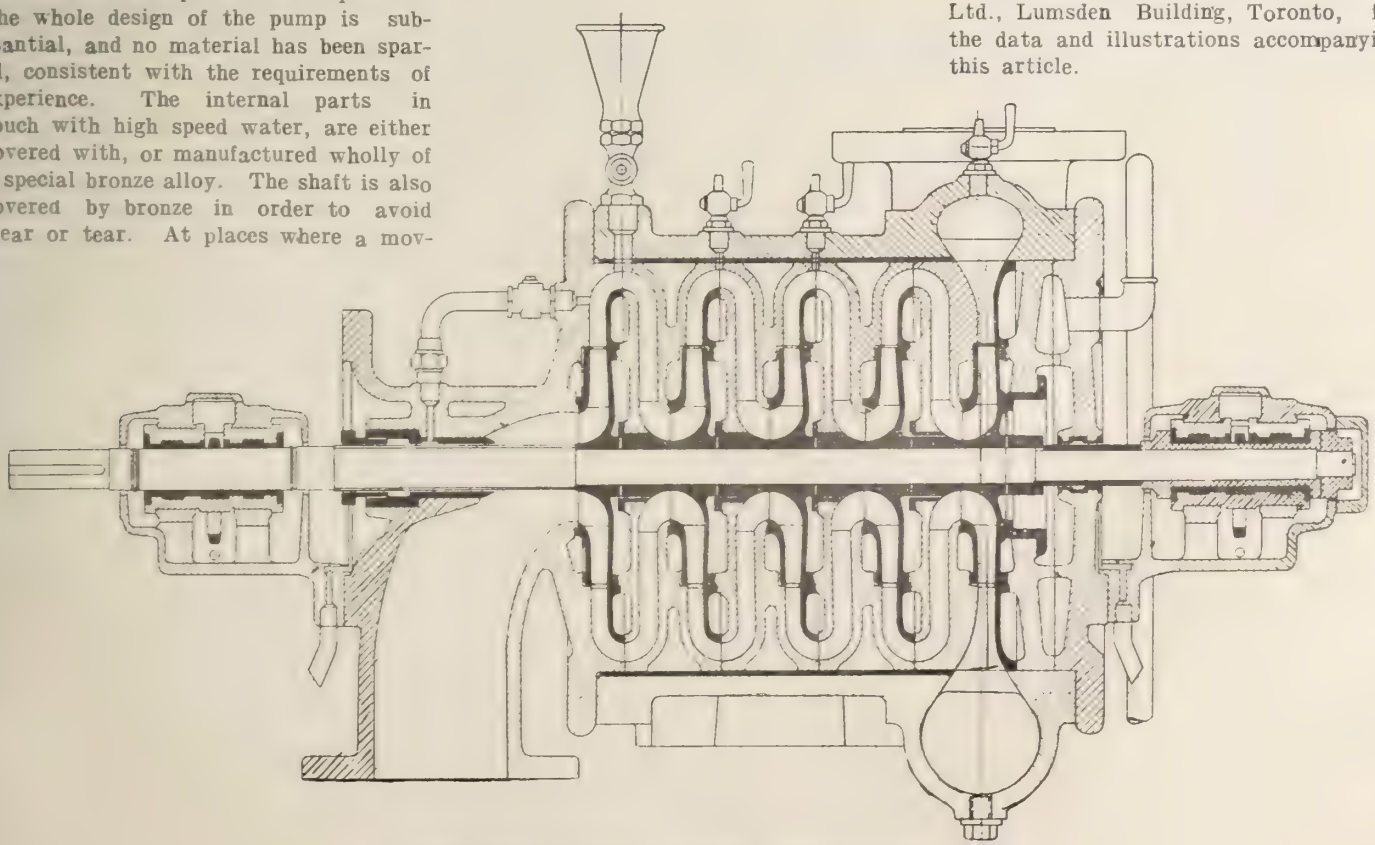
If the pump is of the single suction type, the axial thrust is taken care of by a special balancing device, which adjusts itself, under every running condition. Again if a double suction is provided, the balancing device is not employed, but the shaft receives thrust collars of ample size, to take care of unbalanced thrust due to accidental circumstances, or imperfect equal finish of either side of the rotor. All pumps are supplied with spiral casings; latest experience in their design and working having taught that, by this means, it is possible to increase the efficiency by 1 to even 2 per cent.

Inspection.

With regard to inspection of the internal parts of the pump, it will be noticed that this is accomplished in the most convenient way. No pipes have to be disconnected. The outer bearing has only to be removed, together with cover, and the balancing device is accessible. By removing the second cover, the first guide wheel and runner may be inspected, etc. In order to facilitate the dismantling of the pump, the internal surface of the main casing is covered by bronze so that no rusting is possible, consequently the removal of the internal parts is easily accomplished, even after some considerable time of running.

The diagram shows the performance of an Escher, Wyss & Co. high pressure pump, designed to deliver 500 gals. per min. against a manometric head of 640 feet, when running at a constant speed of 1,450 r.p.m. Efficiencies up to 82 per cent. have been officially recorded by these pumps.

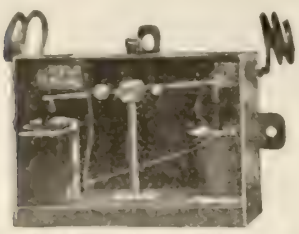
We are indebted to Thv. Heyerdahl, chief engineer, the Escher, Wyss Co., Ltd., Lumsden Building, Toronto, for the data and illustrations accompanying this article.



5 stage, Escher, Wyss & Co., High Pressure Turbine Pump.

THE SHEDRICK CONTROLLER.

In past years, power companies have had considerable annoyance from the theft of power by some flat-rate customers, who install more lights than



The [illegible] Electric Specialty Mfg. Co., Montreal.

they pay for. An instrument designed as a preventative, is the Shedrick Controller, which is adjusted by the power officer, for any given number of lights. As soon as the consumer adds a light more than he is paying for, the lamps flash in and out until the unpaid load is removed. He may, however, connect any amount of apparatus, provided he does not use more than the set current, at any one time.

The controller consists of a bar, balanced in the centre, having on one end a hanging iron core, which fits into the centre of the solenoid, and moves up and down as the load increases or decreases. On the other end hangs an inverted U connection dipping into two mercury cups. The line current passes through the the solenoid, to the first mercury cup, and thence to the other by means of the inverted U. If the load increases, the magnet on the one end of the bar is pulled down by the solenoid, thus lifting the U out of the cups and breaking contact. The lights go out. The consequent stopping of the current in the solenoid allows the magnet to rise and the U again makes contact. The lights come on again. This process is repeated, and intermittent flashing continues while the addition to normal remains.

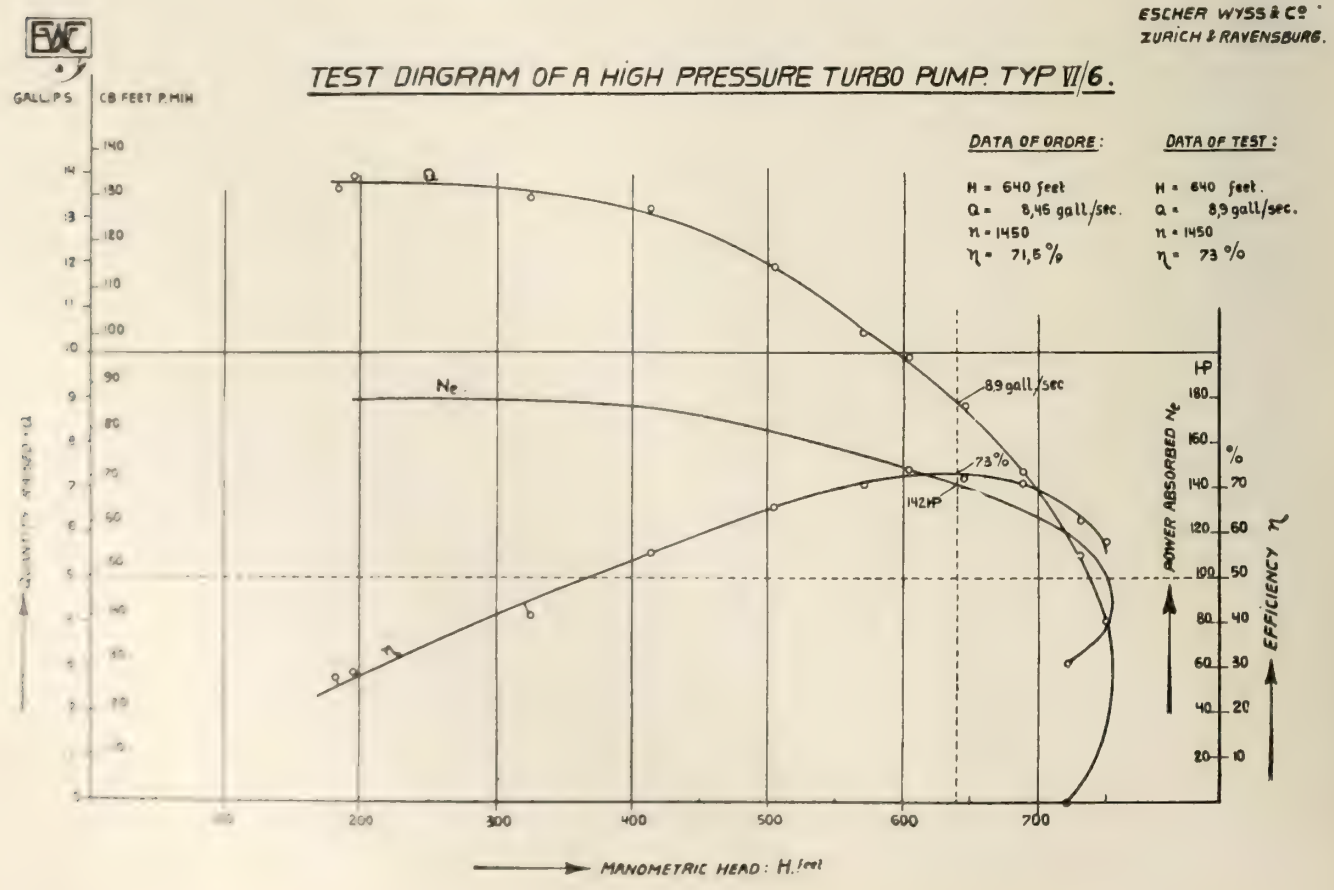
LARGE RIVETED STEEL STACK.

A large riveted steel stack has been recently erected for the new power house of the Cleveland Electric Illuminating Co., where it will serve 18 boilers of 600 h.p. each. The height of the stack alone, is 216 feet. This is increased to 275 feet by the structural supports. The outside diameter is 22 ft. at the top and 40 ft. at the base where it flares out. The diameter inside the brick lining is 18 ft. 6 ins. from top to bottom. While not the highest in the world, it is claimed by the builders, the James McNeil & Bro. Co., Pittsburg, Pa., that this is probably the largest steel stack, considering both height and diameter. The weight of material in the stack proper, not including supports, is given as 400,000 lbs. A total of about 30,000 rivets was used in its construction.

Four different thicknesses of plates are used in the stack walls, decreasing by sixteenths from 7-16 in. thick at the base to $\frac{1}{4}$ in. thick at the top. Each thickness of plate is used over a length of from 35 to 55 ft. The brick lining extends from top to bottom, varying in thickness from $26\frac{1}{2}$ ins. at the bottom to 4 ins. at the top. Its thickness is decreased by steps of several inches each, at intervals of from 30 to 55 ft. The breeching opens into the stack at two points directly opposite each other. The openings are 13 ft. square. The stack is held to its foundations by 14 anchor bolts each 10 ft. long by 2 inch. in diameter. At both ends of each bolt, a length of 6 ins. is upset to $2\frac{1}{2}$ ins. diameter for threading. Four similar additional bolts, each $6\frac{1}{2}$ ft. long, are used at the foot of the jamb posts of the breeching portals.

OMISSION—JULY ISSUE.

It was omitted to mention in the article entitled "Oil Filters," in the section devoted to Readers' Practical Articles, that James E. Noble, Toronto, was the author. Mr. Noble is a regular contributor to the Power House, and we feel he is entitled to all the credit possible.—Editor.



PRACTICAL ARTICLES BY OUR READERS

Readers are invited to contribute to this Department with Short Articles and Personal Experiences—We pay for all Accepted Material.

ENGINEERS' LICENSES*

By R. G. Argue, Dauphin, Man.

MAY I intrude on your valuable space and reply to the article in your August number by A. G. Roffey. I have been a Provincial boiler inspector for seven years, and from what I have seen and learned, must disagree with his article in its essential features. He would make second class men have an experience of five years around machinery; but does not say of what sort, and he would have first class men serve three years in a machine shop. Some of the best men I have met never worked in a machine shop. Three years can be spent to better advantage in the engine and boiler house, getting practical experience in the operation and maintenance of the plant, its boilers, engines and auxiliaries.

The manufacturer wants the man who will keep his plant in continuous operation, and up to par. He should, of course, be able to do his own bench work, and a moderate amount of machine work; but sir, ninety per cent. of engineers have nothing to do with construction and designing; boilers especially being built largely from government approved plans and specifications. All reliable steam units come guaranteed to do their work, and seldom fail. It is up to the first-class man to be able to erect, operate, and maintain them in efficient working order. He should, therefore, be well posted on what would be most suitable for a particular purpose; whether high or slow speed engines, condensing or non-condensing; fire or water tube boilers, open or closed feed water heaters, and other matters of detail which go to make a plant successful in service.

If more were taught and studied on matters of installation, there would be less bungling than at present. Great care is generally taken to have the engine and boilers carefully installed, yet the life of the man who must operate the plant is made miserable by badly arranged piping and misplaced auxiliaries. If examinations partook more of installation and repairs every employer would be money in pocket, for each depends largely on the engineer to care for these matters, and if he, the engineer, bungles them, and leaves for other fields, his successor will have difficulty in proving to his superior that things are not right.

I fail to see why an operating engineer should be a machinist, any more than he should be a boiler maker and a steamfitter. If he spent three years in the machine shop, three or four in the boiler shop, and two at steamfitting, he would still have to learn how to instal and operate. To be a first-class engineer, then, would require an apprenticeship of from ten to twelve years.

There are many ignorant engineers, but a careless one is just as dangerous, no matter how clever he be, or how extended his experience. An engineer with a retentive memory, may at exams. down the man who would in practice beat him in meeting the daily problems of the plant. Exams. run overmuch into mathematics, at which some are quick, while others are slow, yet the latter may be the fastest man in the plant.

Every engineer must read the best and latest concerning his profession, and study to be up-to-date, otherwise he will go back. As we are not older than we feel, we know no more than we learn.

*Government Boiler Inspector, District No. 6.

INJECTOR TROUBLES AND THEIR REMEDIES.

By R. Ewart Cleaton.

Working with a smoothness and reliability, that cannot be excelled by any other mechanical contrivance, when properly handled and carefully maintained in an efficient state of repair, the injector is nevertheless often looked upon by the engineer in charge of the hoist, or other portable plant, to which it is largely applied, as his "bete noire."

It must be admitted, that it is exceedingly exasperating to the engineer to see his steam gauge steadily climbing, and the water in the glass as steadily falling, without being able to locate the defect, and at the same time to have to take the caustic remarks of an irate "boss" whose gang is rendered idle by the holdup, due to drawn fires. However, an injector of approved design and reliable workmanship, and there are such on the market, can be rendered as reliable and efficient as any feed pump, thereby causing a great saving not only in initial outlay, but in working and upkeep. Whereas, it costs only a few dollars to purchase, and practically nothing to keep in running order the pump is vastly more expensive, and costs more to operate and maintain. The writer, therefore, trusts that the following hints may be found of use, when the appliance in question shows signs of refusing to do its duty.

Position on Boiler.

As the proximity of heat is detrimental to a vacuum, the injector should be placed as far from the boiler as possible, by making the horizontal steam connection from the latter as long as convenient. It should protrude at least nine to twelve inches from the side. If it is found that the injector still get warmed up, a hose played upon it will remedy the trouble temporarily. A piece of asbestos millboard placed next to the boiler, will also be of use as a cooling medium. The steam outlet should be placed as high as possible, to ensure obtaining the maximum amount of steam dryness.

In most portable plants, the water supply is obtained on a lift, and when this is the case, care should be taken that it is not greater than that for which the injector is designed; as a rule the shorter the better, for the longer the lift, the greater is the decrease in the injector capacity.

Water Supply.

One of the most common causes of trouble arises from a dirty water supply. This can be obviated in several ways. Where the water to be used carries a great amount of suspended matter, the use of a settling tank is advisable. From this, the water can be drawn off into another tank, or, as is more often the case on contractors' plants, a barrel, in which the suction pipe is placed. The use of the barrel raises another point where care must be exercised to prevent foreign matter introducing itself into the injector. Barrels are used for purposes, many, and varied, and when discarded, often have fibrous, scaly or greasy matter adhering to the sides; care should therefore, be taken to see that all this is removed before inserting the suction pipe, and the end of it should be set at least a foot or eighteen inches from the bottom. This is especially desirable when a settling tank is not employed, as otherwise the end of the pipe will very soon be resting in a bed of mud. Should it be only two or three inches above the bottom, the suction will cause mud to be drawn in, with, of course, disastrous results to the injector.

The suction pipe should be provided with a fine mesh brass or copper strainer to arrest any floating substance that may be in the water. A foot-valve will also materially add to the ease of starting and effect a saving in steam which will soon cover its cost. Should the mesh become dirty and

...ogged, it can be easily cleaned by blowing a jet of steam through it, having of course previously disconnected the foot valve from the suction pipe. Having made sure of securing a clean water supply, the next item of importance to which attention should be paid is piping.

Piping.

One half of the trouble experienced with injectors may be attributed to either using the wrong sort of piping, or defective material of the right kind Rubber piping should be eliminated entirely, as it deteriorates rapidly, with the result that small pieces detach themselves, and thereby undo all the good that has been obtained by ensuring a clean water supply. Galvanized iron pipe should be used in preference to ordinary black, as by using the former, the chance of rust forming and detaching itself, is done away with. Fittings such as tees and elbows should be curved, not square, and preferably of malleable iron instead of cast iron, as a better thread can be obtained on the former, thus ensuring tighter connections, and consequently preventing leakages. The following will be found an easy method of locating a leak in in the piping, should one be suspected.

Locating a Piping Leak.

Plug-up the suction end of the pipe as tightly as possible, and open to its full extent the water regulating valve, after having previously wedged the overflow valve on the injector, so that it will not open. Turn on steam, and the leak will be plainly discernable by a jet of escaping steam. Assuming that the piping system is perfect, it will often be found that the gland in one of the valves is defective, and requires repacking. Unless every gland and joint in the entire system is perfectly tight, the injector cannot be expected to give satisfaction. When the plant is situated in a district having a chalky or limestone subsoil, there is bound to be a great deal of the latter in solution in the water. This is precipated when the steam is raised, not only in the boiler, but also in the pipe conveying steam to the injector, and will in time, cause obstruction to the steam, to the extent of diminishing its velocity. This in turn, will lessen the vacuum necessary for the proper working of the injector. Should such a condition become apparent, disconnect the ... and allow them to soak in a ten per cent. solution of muriatic acid, for at least twelve hours. Make this an overnight procedure, so as to cause ... the opening of the plant in the morning. ... with the engine ... pipe of smaller size than the inlet ... and this is just what happens when the pipes become encrusted by scale. The suction and feed pipe should also be of same size as the injector connections. The priming of the boiler is also another common cause of trouble, as water or oil in the steam supply will destroy the vacuum. If this happen, the cause of priming must be ascertained and eliminated.

Valves.

These should be of brass, and of the globe type in preference to the straightway. Special care should be taken in connecting up the check valve on the feed line between the injector and boiler. Although this may appear an extremely simple matter, nevertheless, trouble is often caused by this valve being carelessly put wrong end on. Should this be done, as is obvious, no amount of rectifying other defects will enable water to be forced into the boiler. If the overflow valve continuously leaks when the injector is working, it should be reground by the aid of a little flour emery.

Starting.

Steam should be turned full on before opening the water supply valve. A common mistake made when starting an injector is to open to its full extent the valve on the suction pipe. One-half to three-quarters of a turn is about the correct amount, and when the latter has been regulated, the steam valve can be used to start and stop, unless the pressure carried, alters to great extent. Too high steam pressure is as great a fault as too low, and when the former is the case, the steam should be throttled, by partly closing the valve.

Capacity.

This is capable of being affected in many ways, such as :—

1—Distance the water has to be lifted if supply is below injector.

2—Height above injector if water is taken from overhead tank.

3—Temperature of water supply.

4—Water pressure, if taken from a main.

5—Steam pressure.

These should be taken into consideration when buying an injector, and the makers consulted as to the most suitable size. Besides stating the above, the type of engine to be used should also be given.

To test the capacity, close the globe valve between the boiler and check valve in the delivery pipe, take off the cap of the check valve, and remove the check. Place a pail under the valve and allow the injector to run for exactly one minute, by timing with a watch. The amount thus collected in the pail, multiplied by sixty will give the hourly capacity. Although the foregoing recommendations may mean a little extra work, and possibly a small additional initial expense, they will, in the opinion of the writer, very soon pay for themselves many times over, by lessening the chance of breakdowns, and consequent loss of time

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PURIFYING FEED WATER.

By Chas. J. Mason, Scranton, Pa.

With regard to your editorial which appeared in the August issue of "The Power House," concerning the importance of purifying feedwater and keeping boilers free from scale, perhaps the following matter may be of value for publication.

A few years ago, I was chief engineer in a street railway power plant, operated by a company with several stations scattered throughout the city. The power stations were under the jurisdiction of an officer designated as superintendent of power. There was a testing department in connection with the plants, which also came under the care of the superintendent of power. When anything of importance was done or discovered in any of the stations, copies of reports concerning such matter, were sent to the chief engineers of all the stations, with a view of keeping them informed, so that the efficiency of all might be raised thereby. With this explanation, the following communications will be easy to understand, as they are otherwise self-explanatory. I purposely omit the names, as it is the data only, that will be of value to the reader. The folowing is a copy of the letter sent from the superintendent of power to the writer.

"Dear Sir :—

I enclose for your perusal and criticism a report from Mr. ——— chief of the testing department, upon the effects produced by cleaning boilers at the ——— power station.

Mr. ———'s report shows a net saving of $1,065 per year, which of course would be proportionately greater in the larger stations of the company. The report emphasizes the advisability of paying a great deal of attention to boiler cleaning, in order to get the best possible return for the money expended; also the advisability of doing any predetermined amount of cleaning in the most economical manner, as it is apparent that an injudicious method of conducting same might easily entail an expense which would be out of proportion to the benefit obtained.

Yours very truly,

Superintendent of Power."

Copy of report referred to in the foregoing letter is as follows:

Effect of Boiler Cleaning in the Power Station.

Mr. ———

Supt. of Power.

Dear Sir :—

Tests were made before and after the boiler cleaning in the ——— Power station ; an interval of two months intervening in the work. The scale taken from the boilers averaged about one-quarter inch thickness. The removal of this caused the heat loss escaping to the stack, to be reduced from 32.3 per cent. to 23.2 per cent.; a net reduction of 9.1 per cent. Before cleaning, an initial temperature in the furnace of 1812 degrees F. was reduced by the passage of the gases around the tubes to 574 degrees F. at the intake—a reduction of 1238 degrees. After cleaning, the improved co-efficient of heat transmission through the tubes, caused a reduction of gas temperature from 2052 degrees F. initial, to 525 degrees F. final,—representing a gain of 9.1 in economy.

Assuming that from one cleaning to the next, the average gain in economy is one-half the gain found immediately after cleaning the net would be 4.5 per cent.

Figuring on two cleanings per year, the saving is about as follows : Approximate cost of coal for the station per year, $58,600.00 ; average saving 4.5 per cent, due to cleaning, $2,635.00; cost of two cleanings at $785, $1,570.00; net saving per year creditable to clean boilers, $1,065.00.

The cost of $785 is the figure given me by Mr. ———, chief engineer of the station, as the actual cost of material and labor for cleaning his ten boilers. This gives the cost per boiler cleaning as $78.50.

The considerable expense of removing the scale, makes important the avoidance of the mistake of cleaning boilers too often. The total expense per year probably depends almost directly on the number of cleanings. The gross gain in boiler efficiency must decrease with the number of yearly cleanings. There is, therefore, a point where this net money saving would be nil, and beyond which the station would be losing money. To determine this question for any station would require more data than we have at present

Respectfully yours,

(Signed) ———.

In conclusion I would say that the station referred to in the letters quoted, contained Babcock & Wilcox water-tube boilers, and was rated as a 4,000 horse-power plant, in round numbers.

The foregoing data may be found of value to those who desire an insight towards higher efficiency of operation, and give them ideas to what to do and what not to do.

LIQUID MEASUREMENT IN TANK

By G. B. Rexford, Vancouver.

A few days ago I was called upon to figure out the amount of liquid of various depths in a horizontal cylindrical tank. As the operation is very long and tedious, it occurred to me that a table could be arranged upon the percentage basis, as follows:—

1% of diameter is X% of capacity.
2% of diameter is X% of capacity.
3% of diameter is X% of capacity.

and so on to 99 per cent., or only to 50 per cent. The remaining per cent. can be easily found by subtracting from the full capacity, i.e., 60 per cent.= capacity—40 per cent. This rule would be very convenient in finding the steam space in a boiler, also the amount of water in boiler by subtracting the cubic contents of flues and stays.

If the above is not close enough figuring, ½ of 1 per cent., 1½ per cent., 2½ per cent., etc., may also be given.

Editor's Note.—Mr. Rexford asks us to complete the table, and publish it for the benefit of our readers. We shall be glad to have readers' views on the subject, and in next issue to suggest a possibly easier solution of the problem.

THE MEYER CUT-OFF GEAR.

By C.J.M.

The article on "Valves and Valve Gears," in the August issue of The Power House, brings to mind an engineers' examination question frequently asked, concerning valve gears with the Meyer cut-off. So many do not grasp the correct meaning of the question, and in consequence make wrong answer, that I thought it would be a good idea to tell my fellow-readers something about it, and thereby, possibly prevent them, it may be, failing to solve it correctly. The question is as follows :

Examination Question.

On an engine equipped with a Meyer cut-off mechanism, admission of steam occurs too soon at the crank end of the cylinder. The admission for the head end is, however, as desired. What must be done in order to equalize the lead at both ends, and have the head end as at present ?

Now, a great many candidates in answering the question, state that certain adjustments must be made on the cut-off part of the gear, in order to gain the desired result. If only a few fell into this error, no importance would be attached to it, but as before stated, so many fail to see that the question and its answer do not at all depend upon the cut-off part of the gear as a whole, it seems timely to convert the wrong impressions concerning it. While the question relates to an engine which has the Meyer cut-off gear, it should be noted that the cut-off valve has nothing whatever to do with the movements of the main valve, but controls only the point of cut-off. The points of admission, exhaust opening and closing, are controlled by the main valve in the same way as with an ordinary slide valve without cut-off mechanism, therefore the question should be considered as though no mention had been made of the cut-off feature of the gear. Answer should accordingly be made somewhat in the manner following.

Suggested Answer.

Shorten the eccentric rod, or make an equivalent movement of the valve itself on the stem (the main valve remember) until the lead is the same at both head and crank ends of the cylinder. As the lead was already correct at the head end, it will now be too much. We can do nothing more then as far as moving the valve on the stem or shortening the eccentric rod is concerned. We can, however, change the angle of advance of the eccentric sheaves, and in this particular case it must be reduced, in other words, placed back of its present position, until the desired lead at both ends is obtained.

Always bear in mind that the main valve and the cut-off valve or valves, as the case may be, are separate and distinct pieces of apparatus, neither having anything to do with the other directly, each being set for the purpose intended.

ENGINEERS' LICENSE LAW.

By W. J. Wilson, Toronto.

PLEASE give me a small space in The Power House, with regard to stationary engineers' certificates. I would like to see this license law more strictly enforced. It does not seem fair, that while some or most engineers must needs have a certificate, others are allowed to escape year after year. I am at present operating a steam shovel, and there are men right alongside of me, in the same capacity without papers. It is up to those in authority to see this license law properly enforced, and to engineers as individuals to give publicity to infringements.

Location of Superheater*

By H. G. BERTRAM, B. Sc.

IF the saturated steam in the boiler is at 150 lbs. pressure, and is superheated 200 deg. F., its total temperature will be 566 deg. F.; therefore, if the

*Fifth article of a series.

temperature of the flue gas is 500 deg., it is evident that it would be useless to place the superheater near the uptake. We cannot even count on having the superheated steam at the same temperature as the gases, since the resistance offered by the metal to the passage of heat is considerable, and is greater with the plates dry than when they are covered with water. This principle is illustrated by the following sketch, which shows that the saturated steam derives more benefit from the heat than does the superheated steam.

The nearer the superheater is to the furnace, the greater will be the transfer of heat per square foot of heating surface, and it follows that for a given degree of superheat, one placed near the furnace will require less heating surface than one placed further away. If, however, we place the superheater where it is exposed to a temperature of over 1,000 deg. F., it will be necessary to provide for flooding with water during the raising of steam or when the superheater is cut out. In most cases, flooding is objectionable, therefore the superheater is usually placed just beyond the 1,000 deg. point.

Further, adaptability to the boiler, and accessibility for repairs, should be considered, so that in no case will it be necessary to disturb the boiler or its setting, to get at the various elements.

Area of Superheating Surface.

To find the square feet of superheating surface required per boiler horse-power, the following formulae have been used and found satisfactory:

Let—

S=superheat in deg. F.

T=temperature of gases where superheater is located.

x=sq. ft. of superheating surface per boiler horse-power.

t=temperature of the saturated steam at the given pressure.

Three B.t.u. are taken as the amount of heat absorbed per square foot of heating surface per hour, for each degree difference in temperature between the gases striking the heating surface and the steam in the tubes. 30 pounds of water is taken as the equivalent of one horse-power.

(1) The heat absorbed per boiler horse-power will, consequently, be equal to $30 \times .5 \times S$.

(2) Heat absorbed by the superheater per square foot per hour—

$$\frac{S}{2}$$

Assuming that $(T-t-\frac{S}{2})$ is the average temperature of the steam in the superheater.

(3) If we equate (1) to (2) we get the number of square feet of heating surface per boiler h.p.,

$$x = \frac{30 \times .5 \times S}{3(T-t-\frac{S}{2})} = \frac{10S}{2(T-t)-S}$$

In equation (3), the only quantity needed is T, which can be found by actual measurement, if the superheater is to be applied to a boiler already working. If this is not possible, the following formula may be used, based on a furnace temperature of 2,500 deg., and a flue gas temperature of 500 deg.:

$$\frac{1}{(T-t)^{.6}} = .172H - .294, \text{ where}$$

T=temperature of the gases,

t=temperature of saturated steam, and

H per cent. of total boiler heating surface between the furnace and superheater.

If H and t are known, a curve can be drawn which will give T for any point in the boiler. As an example of how this works out, suppose we wish to have 150 deg. superheat at 175 lbs. gauge pressure, and assuming that the gases have passed over 40 per cent. of the boiler surface before reaching the superheater, then values can be taken from the following table, in which t=378:

H	T	T—t
00	2500	2122
.10	1852	1474
.20	1431	1053
.30	1143	765
.40	943	565
.50	801	423
.60	699	321
.70	624	246
.80	569	191
.90	528	150
100	500	122

Opposite H=40 per cent., and under T—t we find 565. By substituting this in equation (3) we get:

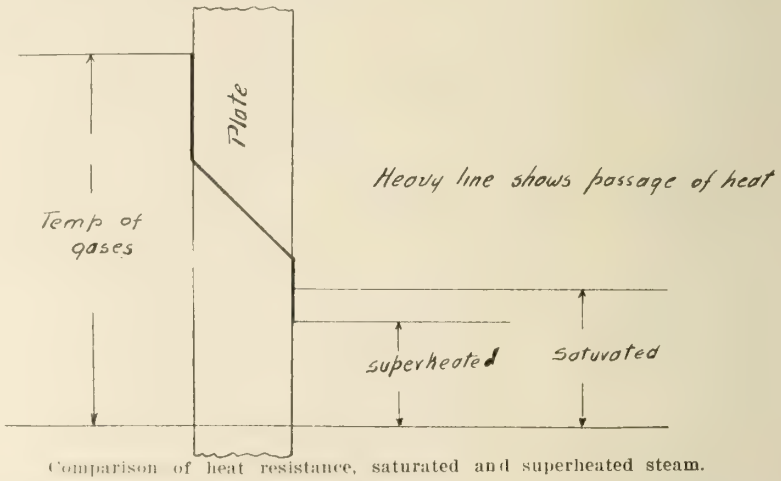
$$x = \frac{10+150}{(565)2-150} = 1.53 \text{ square feet of}$$

heating surface per boiler horse-power. This method has been used in actual practice for the design of superheaters, and has been found quite accurate.

When round pipes are used for the various elements, the steam in passing through them at a high velocity is liable to contain a core of comparatively cool steam—the outer layers acting as an insulator. This would be obviated by having the steam in thin layers, instead of the usual form. Practice has also shown that the best results are to be obtained where the gases and the steam are traveling in opposite directions.

Pipe Material and Expansion Freedom.

Cast iron is acknowledged to be a poor metal for use when a great variation in temperature is expected, and steel is fast replacing it. For the superheating surfaces, seamless drawn tube of heavy gauge has given perfect satisfaction, and considering everything as 2-inch, No. 8 gauge is the cheapest per square foot of heating surface. The heavy gauge is chosen because the tubes will then support themselves in the setting, at the high temperature. Absolute freedom for expansion is essential in each separate element. The U bend is found most satisfactory for this, provided it is not restrained by hangers or other attachments.



Comparison of heat resistance, saturated and superheated steam.

QUESTIONS FOR ENGINEERS.

Q—1. In a certain machine the work that should be obtained theoretically is 800 foot-pounds in a given time. The amount actually obtained, however, is found to be only 576 foot-pounds. What is the efficiency of the machine?

Q—2. What horse-power may be transmitted by a belt 10 inches wide and ½ inch thick running at 42 feet per second; the tension on the slack side being .4 of the tension on the driving side? The stress allowed is 300 pounds per square inch of belt section.

Q—3. If a man can do 3,000 foot-pounds of work per minute, how many such men would it take to raise an anchor weighing 10,000 pounds from a

depth of 30 fathoms in 15 minutes, neglecting weight of chain?

Q—4. A fire engine hose has a nozzle of 1 square inch cross sectional area, and the water is projected with a velocity of 128 feet per second. Find the horse-power of engine required to drive the pumps, if the combined efficiency of the engine and pumps is 60 per cent. A cubic foot of water weighs 62½ pounds.

Q—5.—A safety valve is 3 inches in diameter; the lever is 24 inches long and weighs 15 pounds, its centre of gravity being 13 inches from the fulcrum. The weight of the valve and valve stem is 12 pounds, and the centre line of the valve is 4 inches from the fulcrum. If a weight of 70 pounds is hung on the end of the lever, at what pressure per square inch will the valve commence to blow off?

Q—6. A pump delivers 150 imperial gallons of water per minute. What will be the velocity of flow through a 4-inch pipe?

An imperial gallon contains 277,274 cubic inches.

Q—7. A grade 2 miles long has a vertical rise of 50 feet. What horse-power will be required to haul a load of 120,000 pounds to the top of the grade in 10 minutes, if friction amounts to 5 per cent. of the load?

Q—8. When steam is superheated for the supply of an engine in the usual way its temperature is raised above that in the boiler. Does its pressure also rise? Explain the advantages of superheated steam.

Q—9. What is the meaning of "wire drawing" applied to steam? What is its effect on the indicator card?

Q—10. Sketch and describe some of the methods employed for strengthening the circumferential seams in the flues of horizontal boilers of the Lancashire and Cornish type.

Q—11. Why do the driving wheels of a locomotive frequently slip at starting, and how does the application of sand overcome the difficulty?

Q—12. A bucket conveyor driven by an electric motor is used for lifting coal from a railroad car to a hopper 50 feet above the car. If 40,000 pounds of coal are raised per hour, find the horse-power of the motor. Assume the combined efficiency of motor and conveyor to be 60 per cent.

CARE OF GASOLINE ENGINES IN FREEZING WEATHER.

The following are rules for avoiding freezing of water in the cylinders, pipes, radiators, etc., of the cooling system of water-cooled automobile engines and stationary explosive engines. As soon as freezing weather approaches or when the temperature drops as low as forty degrees F. all water should be drained from the radiators, cylinders and pump, says the Gas Review, and the radiator filled with one of the solutions given.

1. A mixture of glycerine and water in the proportion, by weight of twenty-five per cent. of the former and seventy per cent. of the latter, to which is added two per cent. of sodium carbonate.

2. Chemically pure calcium chloride dissolved in hot water in the proportion of four pounds to one gallon of water.

3. Sodium chloride (common salt) or magnesium chloride dissolved in water in the proportion of one and a half to two pounds to the gallon.

4. Wood alcohol in the proportion of twenty per cent. alcohol to eighty per cent. of water. This solution has the advantage of being sufficient for average winter weather, and it has no ill effect of any kind on metals nor does it leave any sediment.

Should the thermometer reach as low as fifteen degrees F., a solution of about twenty-five per cent. alcohol and seventy-five per cent. water should be used. For temperatures below zero, use thirty per cent. alcohol and seventy per cent. water.—Engineering Contracting.

THE VOLUNTEER STOKERS.

When, at the dictation of the Liverpool Strike Committee, the stokers at Lister Drive power station, gave way to a superior force, it was anticipated that Liverpool would be deprived of its light and street cars until that same committee chose to decree otherwise. The committee, however, had wholly under-estimated the forces with which they had to contend, and it proved a matter of little difficulty to secure the 500 volunteers requisite to keep the power-house going. The volunteers, to say the least, were amateurs. One does not expect a parson to display a great inborn knowledge of stoking, or a clerk to be able deftly to remove "clinker" from the furnace, but the "500" displayed that fine old British characteristic, a capacity for "muddling through all right," and kept the power house going until the striking stokers were permitted to resume work. The experiences of one of the volunteer stokers are recounted in the Liverpool Daily Post and Mercury, and the week's work in the boiler house has so benefited the author technically, that he has even ventured a criticism of the "anteliuvian plan" on which the house is worked.

Experiences Recounted.

The "500" were really a nonedescript collection. It is open to doubt whether any of them had seen a boiler before, but they quickly adapted themselves to their new work. There were three shifts, 7 p.m. to 7 a.m., 7 a.m. to 2 p.m., and 2 p.m. to 7 p.m. A majority of candidates preferred the night shift, for as volunteers, it must be remembered, they had their normal work to perform in addition. There was oiling, greasing, stoking, ash raking, coal unloading, and so forth to be done, and a turn at each occupation was taken by every volunteer. The writer's first commission lay in the furnace pits, removing the ashes and carrying them out. Considerable discussion took place as to the exact costume which was de rigeur for this occasion, and the first choice fell on a garb consisting simply of boots and pants. The gentlemen who first undertook the work, discovered this choice to be an exceedingly unfortunate one, and they suffered no slight inconvenience from the red hot cinders which fell upon their bare backs from above, whilst hunting the ashes underneath the furnace bars. The clerical volunteer was moved to scriptural reflections, and would have gladly accepted the aid of Shadrach and his comrades as more acclimatised assistants. Eventually the situation was met by wearing water-soaked shirts and a species of turban similarly treated.

Antediluvian Power House Methods.

This "antediluvian" mode of removing ashes, moved the writer to indignation. He considers Gladys Sybil, his cook, ahead and well ahead of the Liverpool Corporation in these matters. Her mode of removing the ashes is simplicity itself, and he can hardly bear to contemplate the consequences of asking her to remove the ashes by running under the fire as they do at Lister Drive.

Another turn was the removal of the red hot clinkers from the furnace, and their conveyance to the exterior of the power house. The first attempt to wheel the barrow and its red hot load in the orthodox fashion, i.e., in advance, proved a dismal failure, and the writer speaks feeling on the correct mode to be employed. His skin was badly burnt, and even when he resorted to the reverse manner of progress, it required some experience ere the necessary skill was acquired. The clinker rakes too seemed to have been endowed with unaccustomed perverseness, and as a memento of the occasion he suggests that the boiler room be presented with a new set of rakes, an urgent necessity as he seems to think. The coal unloading proved far more to his taste. It was hard work, but it was performed in a more congenial atmosphere, which seems to have induced a healthy spirit of rivalry between the gangs unloading the various trucks. The writer's gang's best time for a 12-ton truck was forty-two minutes, a performance which was completely eclipsed by a gang in the next bunker who did it in twenty.

The writer has a sorry tale to relate of the reception accorded to these heroes when they arrived home in their grimy clothes and unrecognizable countenances. The wife of one repudiated all knowledge of him, and another was ordered around to the back door. His most noticeable personal experience in this direction was a contemptous rejection of his garments [illegible].—The Electrical Times.

Personal

James Crombie, foreman of the boiler department of Sawyer-Massey Company, Hamilton, Ont., and a member of the executive board of the Master Boiler Makers' Association, has accepted the position of general foreman of the Oil City Boiler Works, Oil City, Pa.

* * *

Mr. Walter Pettigrew, chief of the estimating department at the John McDougall Caledonian Ironworks, Montreal, recently joined the ranks of the benedicts. The fortunate lady is Miss Greene, St. Lambert, P.Q. On conclusion of the honeymoon, which is being spent in Washington, Mr. and Mrs. Pettigrew will reside in St. Lambert.

* * *

We regret to announce the death of William Sclater which took place at his home in Westmount, Que., on Sept. 9th. The deceased was widely known in Montreal business circles, and highly respected. Mr. Sclater was founder and proprietor of the firm of William Sclater & Co., dealers in engineers' supplies.

* * *

J. D. Evans has been appointed resident engineer for J. G. White & Co., on the Canadian Light and Power Co. works, and supervising engineer and superintendent of construction for the Montreal Street Railway Co. Previous to coming to Montreal Mr. Evans was in charge of the engineering and construction work of the Buffalo, Lockport and Rochester Interurban Railways.

C.A.S.E. Reports

London, No. 30, C.A.S.E. have started [illegible] works, and arrangements are such, that instruction will begin right from the [illegible].

Port Arthur, No. 29, C.A.S.E., the youngest branch of the order, reports progress in its work of bringing all stationary engineers within reach of the benefits derivable from membership in the association. In giving expression to the generally accepted view, that no engineer can be a member for any length of time, without receiving a substantial benefit, our contributor points out the other and equally important fact that while the association can do, and is doing much for the members, they as individuals should not fail to do all they can for themselves.

* * *

Owen Sound, Lodge 25, C.A.S.E. held a largely attended meeting on August 24th, at which one new member was added. The recently acquired room for lodge purposes, is proving a great boon, providing as it does, place and opportunity peculiarly our own, to discuss questions and solve problems arising out of our daily work, and concerning our professional progress.

On Labor Day we joined in a monster parade, and took part in various sports held in connection therewith. A water fight with fire hose and nozzles between three engineers and three moulders, was won by us, G. E. Thomas, E. Hooey and R. Mitchell shared the honor. The 100 yds. race for engineers was won by J. Kaye; R. Mitchell and E. Hooey being 2nd and 3rd respectively. A tug-of-war between masons and engineers, five-a-side, was won by the former. A greasy pig contest provided much amusement, and was taken part in by several of our members, neither of whom was, however, able to hold "grumpy." Three bands took part in the procession, that of the pipers' being most in favor. No untoward event marked the day's outing, and as a result of a well managed programme, we were enabled to donate $50 to the General and Marine Hospital, Owen Sound. Our lodge meets every Thursday at 8 p.m., and in order to familiarize ourselves with manufacturers' products for power plant purposes, receipt of catalogues and samples will be esteemed.

* * *

Stratford, No. 31, C.A.S.E.—At the last regular meeting of the Stratford Lodge, No. 31, of the Canadian Association of Stationary Engineers, held Sept. 13, the popular president, Mr. A. Kastella, was handsomely remembered, being the recipient of a purse of gold from his fellow members, accompanied by an address. Mr. Alex. Scrimgeour, past president of the lodge, read the following address in making the presentation:

"Mr. A. Kastella, President Stratford Lodge, No. 31, C.A.S.E. Esteemed brother,—The 22nd annual convention of the Canadian Association of Stationary Engineers, recently concluded, was justly considered in every way the best yet held in the history of the C.A.S.E., and as the success of this convention was very largely due to your untiring efforts as chairman and secretary of the convention committee, we, the members of Stratford Lodge, No. 31, take this opportunity of expressing our sincere gratitude for the able and satisfactory way you carried through all matters pertaining to the office which you have so successfully filled.

"Remembering the many hours of your valuable time spent in connection with this work we feel that we could not let this opportunity pass without in some small way showing our gratitude for the able manner in which you attended to the many matters which came before you, and we therefore ask you to kindly accept this purse of gold as a small token of our esteem and appreciation.

"Signed on behalf of Stratford Lodge, No. 31. J. A. Robertson, Alex Scrimgeour, G. W. Hird."

Mr. Kastella made an appropriate reply, expressing his deep gratitude at the unexpected honor.

Stratford No. 31, C.A.S.E.—Bros. Griffin and Morenz who have been on the sick list for some time, are expected to return to duty shortly.

* * *

NOTES ON CONSTRUCTIONAL DETAILS.

Every machine or structure is designed with a certain object in view; therefore in designing, keep that object always to the front and let it influence every thought and action. Go straight to the point and let the object be attained in as simple and direct a manner as possible. It should be remembered that machines and other structures designed in this way, with the least material for the work to be done, usually look well and cannot be improved in appearance by outward embellishments.

Parts subject to stress should have as little change in form as possible, and if change is necessary it should not be of a sudden nature; these remarks especially refer to cast iron, where a sudden angle or opening with square corners (even if not very sharp) may cause fracture when the section might be thought more than ample. Steel castings should be as simple and as free from ribs or brackets as possible. Ribs or nerves which run lengthways are not, however, as objectionable as those across the lines of principal contraction, but the soundest of metal under such projections is often doubtful, so that they may be a source of weakness instead of strength.

NEW EQUIPMENT *for* POWER PLANTS

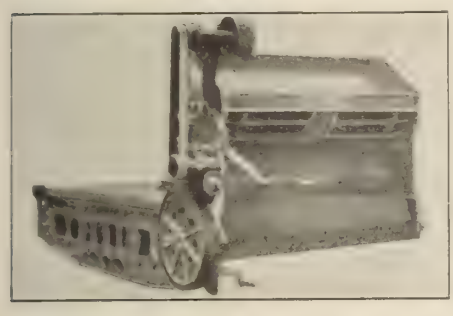
To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

THE BENNIS STOKER.

BOILER house methods of fifteen years ago are now more or less antiquated, and with enterprising and go-ahead firms, obsolete. Steam engineering, whether it belongs to the central light and power station, the well-equipped textile mill or the general manufacturer, is to-day conducted scientifically; the man in charge being a trained and responsible engineer.

Boiler-House Economy.

The subject of boiler-house economy is one to which is being given increased attention everywhere. Edward Bennis & Co., Bolton, England, have by a long series of costly experiments, extending over many years, evolved machine-stokers of several types, applicable to the leading designs of boilers—shell, tubular, etc.



The "Bennis" New-Link Chain Grate Stoker.

The "Bennis" machines are not merely one machine adapted to many uses, but are distinct types doing successful work on water-tube, return tube, and other shell boilers. A conspicuous success on water-tube boilers, is the "Bennis" High Temperature Coking Stoker, which burns low-grade cheap fuel without smoke, and increases the steaming capacity of the boiler by as much as 30 per cent. to 35 per cent., while reducing the fuel bill. This machine is installed in the boiler-houses of many electric light and power stations, paper and pulp mills, breweries, flour mills, chemical works, steel rolling mills, textile mills, and, in fact, wherever great flexibility is required in response to varying load. A distinctive feature of the machine is its ability to light up the fire rapidly, so that the fuel is coked as fast as the compressed air furnace can burn it. This coking stoker efficiently meets the demand for large evaporation and economy without smoke, smuts and grits.

The "Bennis" sprinkler machine is applicable to water-tube boilers and those of the Lancashire type. It keeps strong, bright fires without smoke with poor unwashed and unscreened fuels, and is a great favorite in dye-works, calico printing works, spinning and textile mills, pumping stations, sewage works, and wherever heavy and variable loads are carried.

The "Bennis" new-link chain grate stoker is minus the awkward joints between the links which tend to interrupt the continuity of surface. The links are so designed, that there are no gaps between them at the joints, through which small coal can fall and impede the working. Fuel can be fed on to the furnace at any point, an advantage that means an increased available surface for the purposes of combustion. There is no wasteful excess of air admitted, in this newer type of chain grate, as an effective system of air seals excludes the possibility.

The "Bennis" chain grate stoker is installed in leading electric light and power stations of Great Britain, where watertube boilers are largely in use, and is giving satisfaction by reducing fuel costs, increasing steam, minimising labor and rendering the work of the engineer less harassing and onerous.

Ed. Bennis & Co. have prepared an interesting and complete series of illustrated pamphlets giving detailed particulars of various installations of their machine-stokers in all the best known industries. These may be had on application to George Tod, Manning Chambers, Toronto, who represents Ed. Bennis & Co. in Canada.

3 H.P. Motor Driven Luitwieler Pump.

A NEW TYPE OF PUMP.

The Luitwieler Pumping Engine Co., Rochester, N.Y., are manufacturing a pump of a non-pulsating type, which is

A range of "Bennis" New-Link Chain Grate Stokers.

claimed to effect large economies in power consumption. The principal feature of the design lies in the balancing of all the reciprocating parts and the elimination of dead centres. The Luitwieler pump is operated by cams set on the cam shaft, 180 degrees apart, and arranged so that the lifting stroke covers 53 per cent. of the cam surface. The return stroke is made on the remaining 47 per cent., so that while cam No. 1 is lifting, cam No. 2 is moving the pump piston down, and begins to lift before cam No. 1 has finished its upward stroke. By this means, dead centres are eliminated, and the water movement made continuous without jar, vibration, back lash on gears, or water hammer. The balance is so perfect that the pump will work under full load on an ordinary floor without holding down bolts.

These pumps can be supplied with belt, motor, gasoline or steam engine drive, as desired.

The cut shows a 3 h.p. motor driven pump under test. The apparatus was laid on four water glasses placed on a saw horse. An ordinary lead pencil was then placed upright on the top of the frame, and may be seen in the photo, showing no trace of vibration, although the exposure given was eight minutes. The motor speed was 1500 r.p.m., the pump made 90 single strokes per minute, and delivery of 75 gallons per minute was made against a head of 48 pounds.

The Canadian agents for the Luitwieler Pumping Engine Co., are the General Machinery Co., Traders Bank Building, Toronto.

Power Appliances at the Canadian National Exhibition

The Recent Annual Canadian National Exhibition at Toronto was Well Up to Its Usual High Standard of General Excellence, and There was Much to Attract the Interest of Power Users and Operating Engineers. Inspection of the Mechanical Appliances was Largely Taken Advantage of, and Most of the Exhibitors Reported Numerous Inquiries and Sales.

LIST 1.—EXHIBITORS.

The James Morrison Brass Mfg. Co., Toronto, were located in the Process Building. Numerous and varied specimens of their well-known products were on view, such as steam and hydraulic pressure gauges, engine counters, injectors, stop valves, marine engine-room telegraphs, etc.

The Linde British Refrigeration Co., Montreal, exhibited a belt-driven 20-ton ammonia compressor, operating in the Dairy Building. It was employed to care for the exhibits of the Farmers' Dairy, the City Dairy, the Harris Abattoir, and others.

The Chapman Double Ball Bearing Co., Toronto, had a comprehensive exhibit of their annular ball bearings and double ball thrust bearings. In order to demonstrate the small amount of power absorbed, seven bearings, large and small, were placed upright on the floor, in line, and driven from a countershaft by "belts" consisting of fine wire; the countershaft itself being driven from the line shaft by similar

The Boiler Repair & Grate Bar Co., Toronto, were demonstrating their shaking and dumping grate. They also exhibited Bundy steam traps and other specialties on behalf of H. L. Peiler & Co., Montreal.

D. K. McLaren, Ltd., showed their well-known British oak-tanned leather belting, in numerous sizes, besides [illegible] pulleys, and other belt supplies.

The Canada Metal Co., Toronto, had [illegible] pipe joints, plumbers' supplies, fuse wire, battery zincs, pig lead, [illegible] their brands of babbitt were on view, the "Harris Heavy Pressure" occupying a prominent place.

The Positive Clutch & Pulley Works, Toronto, exhibited a number of their wood-rimmed pulleys, with pressed steel spokes and malleable iron hubs. A feature of these pulleys is their absence of windage. A combined jaw and friction clutch was also shown. In this friction, pieces made of fibre are employed to gradually pick up the speed of a shaft or pulley under load, after which the positive jaws are thrown into gear, the friction being disengaged at the same time. The whole operation is controlled by one lever.

The Cling-Surface Co., Buffalo, were distributing literature and demonstrating the merits of their well-known belt dressing.

The Acheson Oildag Co., Sarnia, Ont., showed samples of Oildag and Aquadag. The former is a lubricant consisting of deflocculated graphite suspended in oil, and is meeting with much success. Aquadag is used as a cutting compound on lathes, milling machines, etc., and in it water takes the place of the oil in Oildag.

The Tallman Brass & Metal Co., Hamilton, made a good display of their Arctic Babbitt Metal, as well as of brass rods and tubing, brass castings, brass signs, etc.

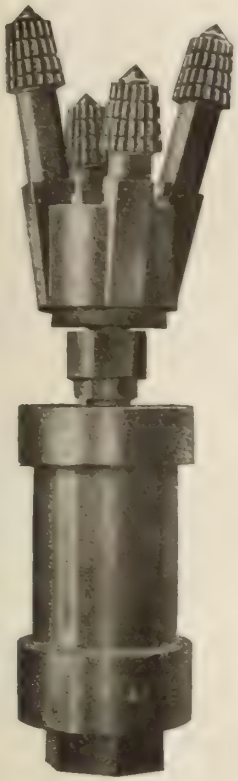
The Canadian Steam Boiler Equipment Co., Toronto, gave chief place to their Cyclone shaking and dumping grate bar. They had also on view boiler feed pumps of the direct acting type, and Economic vacuum valves.

The Twin City Oil Co., Ltd., Berlin, Ont., are general agents in Ontario and Quebec for the Manzel sight feed oil pump, several examples of which were to be seen at their booth. This pump is designed for positive and economical lubrication of engine cylinders under all conditions. It is of the double plunger type, one plunger drawing the oil from the reservoir and forcing it through the sight glass, and the other plunger forcing it into the cylinder. Another interesting exhibit at this stand was the Ideal Packless Valve. In this valve the function of packing is performed by a composition and metallic disc, which is integral with the stem and revolves with it on a ground seat in the top of the valve bonnet. The valve is suited for high or low pressure, and is specially recommended for radiator work.

The Consumers Gas Co., Toronto, had a Crossley gas engine in operation, besides a number of gas accessories of various kinds. A furnace for hardening or annealing high-speed steel was shown, in which the gas entered at the top instead of at the sides, as is usual. A steam boiler, fired by gas, was a novel feature of this exhibit. In this boiler the size of the gas flame is automatically regulated by the pressure of the steam.

The Dominion Belting Co., Hamilton, Ont., had a well-arranged booth, in which they showed their Maple Leaf brand of driving and conveyor belts, made of high-grade stitched cotton duck.

Self-Measuring Pumps, Ltd., Toronto, had an attractive exhibit. These self-measuring pumps are a great convenience in a large engine room, automobile garage, railroad roundhouse and other places where large quantities of oil are used. An adjustable stop on the pump rod varies the travel of the plunger, and so controls the amount of oil delivered at each stroke.



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TUBE CLEANER

Saves Time! Saves Money! Saves Worry!

It is the most compatible device for removing all Boiler troubles caused through scale.

As one-eighth of an inch of scale means a fifth decrease in Boiler efficiency, it also means a fourth more fuel consumption than is necessary to make the required steam.

The LIBERTY Tube Cleaner is guaranteed to remove all scale rapidly, and will prevent accidents from burnt out tubes.

It can be operated by air, steam or water.

Let us help you cut out unnecessary expense by writing to us at once.

Liberty Mfg. Co.

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PITTSBURG

PA.

Impure FEED WATER will be a thing of the past in your plant if you instal a "TWIN" Strainer.

It is the most efficient protection yet invented for valves and injectors, as it keeps them entirely free from twigs and other injurious substances present in all FEED WATERS.

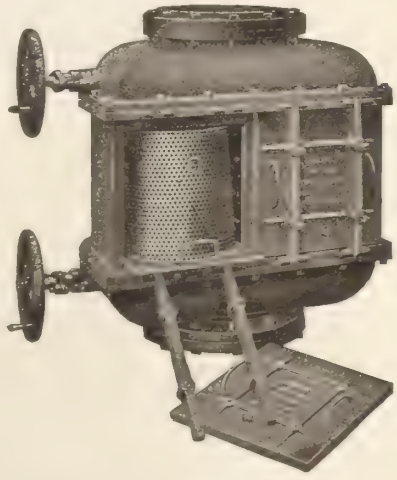
THE TWIN
STRAINER

The "TWIN" is an invention born of necessity, and every boiler room must profit from its use.

Either side of the "TWIN" Strainer can be easily cleaned separately without interrupting the flow of water.

Write us for fuller information and let us quote prices.
It will be to your advantage.

The Liberty Twin Strainer.



Elliott Company

6902 Susquehanna Street

PITTSBURG : : PENNA.

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POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

BRITISH COLUMBIA.

VANCOUVER—The contract has been awarded by the management of the B.C. Electric Railway company for considerable extensions to its gas-driven steam power plant located at the rear of the sub-station on Main Street. The approximate cost of the work is $250,000. The work is to be completed by December 18. C. C. Moore & Co., Seattle, who installed the original steam auxiliary plant and made record time, received the order.

The undertaking includes the erection of a reinforced concrete stack nearly 260 feet high at a point 75 feet west of the present stack. The stack will be similar in construction and dimensions to the present one.

The contract for equipment calls for four Babcock & Wilcox boilers, each of 500 horsepower. These will operate a 2,000 k.w. Allis Chalmers turbo-generator. The contract also covers complete installation of piping, condensers, etc., to put the entire plant in readiness for operation.

It will result in increasing the available power from the steam auxiliary plant to 12,000 horsepower. Work has already been started.

PRINCE RUPERT—The work of making the surveys in connection with the plans of the Prince Rupert hydro-electric company has been going on here for some time. The programme recently adopted by the board of directors contemplates the expenditure of $600,000 during the next twelve months and $2,500,000 within the next four years. The company was recently incorporated with an authorized capital of $5,000,000. It represents a merger of the Tsimpsean Power and Light Company, and the Continental Power Company, owning exclusive water rights on the Kahtada river, forty-two miles from Prince Rupert, and at the Falls on the Exaw river, twenty-eight miles from the same city. English, French and Canadian capitalists are interested in the proposed enterprise. The president is C. H. Cahan, K.C., of Montreal, president of the Western Canada Power Co., which is developing Stave Lake Falls for supplying power to Vancouver and other points on the lower mainland. The general manager is R. F. Hayward, who occupies a similar position with the Western Canada Corporation.

EDMONDS, BURNABY.—The Western Canada power by-law and the Waterworks merger by-law were carried.

KERRISDALE.—The ratepayers passed the [illegible] to spend $501,250.80 for waterworks [illegible].

NANAIMO.—The ratepayers passed the $50,000 sewerage extension by-law and the B.C. Hydraulic Power Co. agreement.

ALBERTA.

ALIX—An electric light and power plant [illegible] cost of $20,000. The Redhead Electrical Co., of Calgary, was [illegible] calls for completion by November 1. Tungsten lamps [illegible] Power for manufacturing purposes will be available, and is estimated at 200 horse-power.

EDMONTON—The ratepayers defeated the by-law to grant a gas franchise to the International Heating & Lighting Co.. A by-law to provide for the establishment of a municipal gas plant will likely be submitted [illegible].

LACOMBE—The ratepayers voted $40,000 [illegible] electric light plant.

MEDICINE HAT—The town will expend $15,000 [illegible] electric light plant.

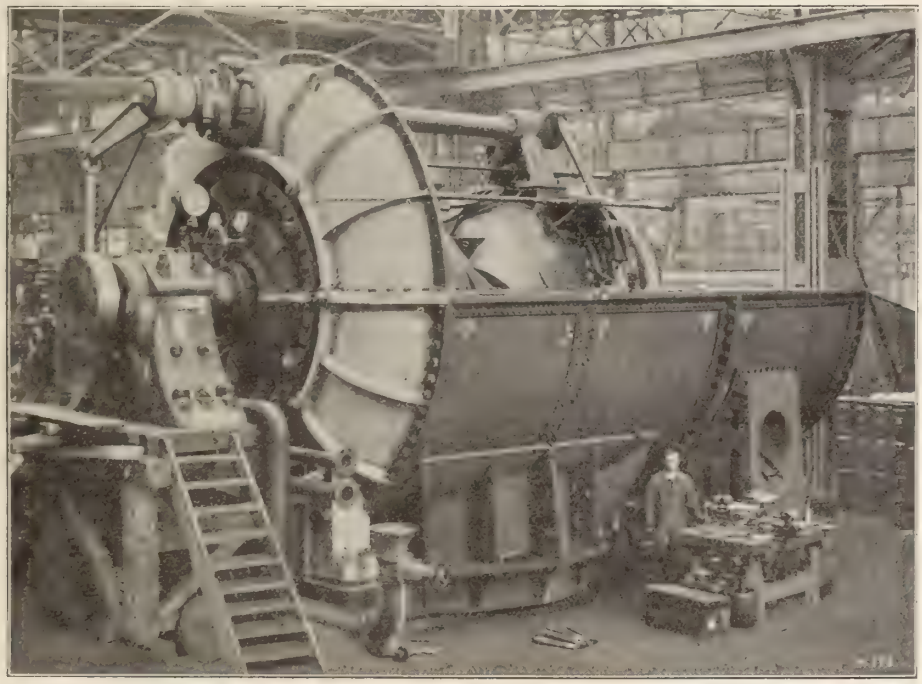
SASKATCHEWAN

SASKATOON—The [illegible] for the new 4,000,000 gallon per day waterworks plant [illegible] and city will install in the [illegible] supplied by the electric [illegible] Consolidated [illegible] Power Co. [illegible] Power is [illegible] the city will be in a [illegible] if required. [illegible] received here, the [illegible] This [illegible] at a depth of [illegible] feet, [illegible] [illegible] [illegible]

Hydro-Electric Plants
Water Turbines

5,000 SUPPLIED. 2,000,000 HORSE POWER.

Any Out-put



Any Head

Two 13,000 H.P. Turbines, as illustration, on order for the Western Canada Power Company, Vancouver

ESCHER, WYSS & CO.
ZURICH, SWITZERLAND

CANADIAN HEAD OFFICE:
Room 408, Lumsden Building, Toronto

Phone: 234, Adelaide. Cablegrams: Neumuehle, Toronto

Don't fail to mention this paper in writing to advertisers.

The Canadian Boving Co., Toronto, report the following orders recently received: One [illegible] pump, direct connected [illegible] capable of delivering [illegible] gallons per minute against a head of [illegible] feet, direct connected [illegible] to be operated by Hydro-Electric power from the Hydro-Electric Co., and the pump to be capable of delivering 2,100 gallons per minute against 58 feet head. Both pumps are to the order of the Town of St. Thomas, Ont. One 100 h.p. Diesel engine for direct connection to dynamo, for each of the Towns of Wilkie and Scott, Sask. Two 190 h.p. impulse wheels to work under 2,050 feet head, at a speed of 900 revolutions [illegible] also two direct connected three-[illegible] generators for same. About 10,500 feet of [illegible] welded steel plate pipe line.

Escher, Wyss & Co., hydraulic engineers, of Zurich, Switzerland, Canadian Head Office, 68 Lumsden Building, Toronto, have lately received an order from the Rio de Janeiro Light and Power Co., Mexico, for two 19,000 H.P. tangential wheels, the largest of their kind, to work under a head of 950 ft. This contract includes delivery of Escher, Wyss & Co.'s patent oil-pressure governors as well as the two pipe lines, complete with valves, etc. Further orders have been received from the Tata Hydro-Electric Power Co., Bombay, for four 13,200 H.P. and two 1,000 H.P. high-pressure turbines designed for a head of 1,680 ft., and from the Fuji Cotton Mill (Japan) for four 3,000 H.P., and one 100 H.P. turbines designed for a head of 280 ft. These orders also include delivery of the necessary number of Escher, Wyss & Company's governors.

Orders of water turbines booked in the course of last month exceed 130,000 H.P.

Laurie & Lamb, Montreal, Have received from Price Brothers & Co., Jonquieres, P.Q., the contract to instal Foster Superheaters on their 8-350 H.P. horizontal return tube boilers. They will also supply a Kellogg radial brick stack of dimensions 125 feet by 8 ft.

Laurie & Lamb, Montreal, are installing Heenan & Froude Refuse Destructors to the order of the cities of Ottawa, Moose Jaw and Calgary, in connection with their various power plants.

CATALOGUES.

The Dominion Belting Co., Hamilton, Ont., are distributing among their customers and friends a set of pretty girl blotters, emblematic of various well-known flowers.

"Hydraulic Pumps, Catalogue No. 81" is the title of a new 120-page 6x9 catalogue descriptive of many standard, and several new types of hydraulic pumps. This catalogue, issued and sent free by the Watson-Stillman Co., 50 Church Street, New York, contains valuable information for hydraulic engineers and users of hydraulic machinery.

The Dudbridge Iron Works, Stroud, Gloucester, England, have issued an 18-page catalogue, descriptive of the Dudbridge new type gas engines and gas producer plants. The constructional details are fully illustrated and described, and show features worthy the attention of all interested in this form of power generation.

Jeffery Correspondence Schools Endorsed

¶ On page 616, August edition of "The Boilermakers' Journal" a correspondent, signing himself "By a Brother," after being benefited himself, endorsed Mr. H. S. Jeffery, of the Jeffery Correspondence Schools, as follows:

> One of our brothers is willing to teach you for a low figure, as seen in the advertising pages of this Journal. I am not his agent, have nothing to do with his school, but he has helped me in book learning very much, has thrown all his ability, knowledge and experience an our side when the federal locomotive boiler inspection bill was up for consideration in Congress, and thus if you want to acquire theoretical knowledge I say give him a chance before anyone else. He has the knowledge, ability and experience to help you far more than any professor or mere theoretical man. You want practical knowledge, such as I have given or tried to give you here, and such you will get of our brother, H. S. Jeffery.

¶ **We have a Message to You:** Our Schools will have **Practical Men** to answer your enquiries: **we will not have girls and women, who are paid from $3 .00 to $50.00 per month** (as other schools have), to answer inquiries. **Our instructors will be men who have graduated from the ranks.**

¶ Mr. Stationary Engineer and all mechanics, we are going to publish a **great mechanical monthly,** called the **Twenty Century Mechanics.** Here is our offer to the first 5,000 subscribers:

Twenty Century Mechanics for one year	$1.00
One share of common stock in the Jeffery Correspondence Schools, par value	1.00
Membership in the Jeffery Correspondence Schools	1.00
Total	$3.00

¶ **Cut out this advertisement** and mail with $1.00, and you will get the three items listed above. **Act now** or never; this advertisement will not appear again; the offer is good to the first 5,000 subscribers **only.** Address,

JEFFERY CORRESPONDENCE SCHOOLS

KEEFER PL. WASHINGTON, D. C.

The Devoe Electric Switch Co.

Switches
Switch Boards
Switch Boxes
Panel Boards

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157 Craig West, - MONTREAL

Chas. Barber & Sons

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WATER POWER EQUIPMENT ONLY

Write for Catalogue

GIFFORD TRAPS

Return, Lifting & Vacuum
The Newest & the Best
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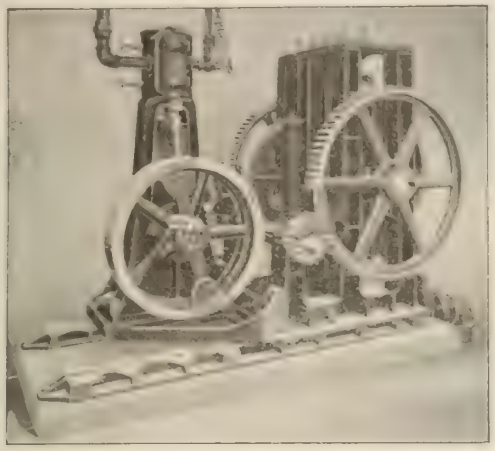
The Least Expensive.

Write for Particulars.

Percival F. Gifford
505 Power Building MONTREAL

A Dollar Saved Is a Dollar Earned

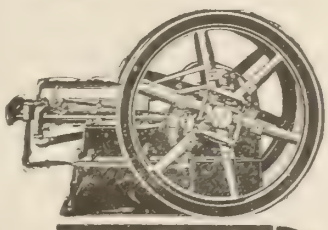


Luitwieler Pumping Engines will Save You Dollars Year in and Year Out

1st In the Cost of Power for Pumping
2nd—In the Cost of Maintenance and Repairs.
3rd—In the loss of time through delays.

The General Machinery Co.,
LIMITED
526-7 Traders Bank Bldg., Toronto

The Hardest, Cheapest, and Steadiest Worker on Your Pay Roll



An I H C gasoline engine in your shop or plant, belted to small or large machines, will work harder, steadier, and for less money than any man on your pay roll. I H C gasoline engines are made by a company which has never made anything but highest quality machines, and are backed by a concern with a reputation that insures your satisfaction. They have proved their simplicity, economy, strength, and durability to thousands of shop owners, factory owners, repair men, and whoever else has ever used them.

IHC Gasoline Engines

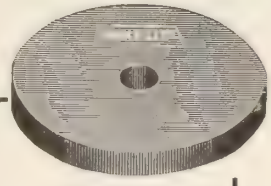
are built to last and give service year after year for the longest time.

No matter what you want an engine for, write now for the I H C Catalogue. It tells all about the I H C engines, in all sizes from 1 to 45-horse power; in all styles, vertical or horizontal; stationary or portable; air or water-cooled; tractors, 12 to 45-horse power. Wait till you see the I H C catalogue before you decide.

Address

International Harvester Company of America
(INCORPORATED)
50 HARVESTER BUILDING CHICAGO U S A

Valve Discs from the Wonderful New Material



Bakelite

BAKELITE has sounded the doom of valve discs of every other material, and for the following important reasons:

BAKELIGHT Discs can be used universally for cold water, wet or dry steam, super-heated steam and chemicals.

BAKELIGHT Discs are made under high temperature and will, therefore, meet the conditions of high temperature service. They are affected by absolutely nothing except careless handling and friction, having great strength and hardness. They stand excessive wear and can, when necessary, be reground and refaced, always retaining a uniform surface.

BAKELITE Discs are a boon to valves which are constantly giving trouble owing to the use of special liquids, high pressure and high temperature—they cannot become soft.

Do not use high priced special metal discs when BAKELITE is Better and Costs Less Money.

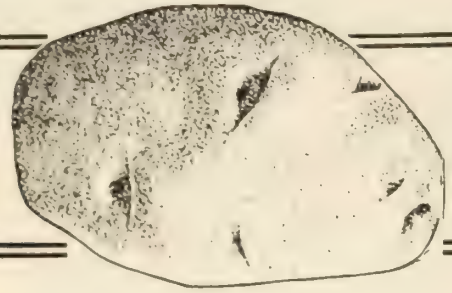
Order BAKELITE Discs from your dealer and use them anywhere in the plant. You will never use anything but BAKELITE Discs when you have once tested them. They mark a new era in valve efficiency.

WRITE US DIRECT IF YOUR DEALER HASN'T THEM

Eastern Agents for Bakelike Valve Discs
Eadie-Douglas, Limited, Montreal

PLASTICS Limited
148 VAN HORNE STREET
TORONTO

Potato Scale Boiler Cleanser



Guaranteed to remove all scale from your boiler without the slightest injury to the tubes. Keeps the water in the boiler from foaming.

Send me a gallon of your feed water we will analyze it and mix you a compound that will not only remove old scale but will prevent fresh scale from forming.

Give it a fair trial and if it doesn't do what I claim, I will cancel the charge for the amount. ***Write at once.***

C. C. Snowdon, Wholesale

P. O. Box 1384 - - CALGARY, ALTA.

WALKER'S ELECTRIC BOILER COMPOUND

WE GUARANTEE

that this Compound will eliminate your boiler troubles resulting from scale.

Wherever used it has given perfect satisfaction, and has been the means of cutting down fuel bills and increasing boiler efficiency.

If used regularly it will keep your boiler absolutely free from scale without the slightest injury to either boilers or pumps.

Give it a trial—if unsatisfactory it will cost you nothing.

The Electric Boiler Compound Co.
Limited
GUELPH - ONTARIO

DEARBORN FEED WATER TREATMENT

Guard Against Scale

How are the conditions in your plant? Are you burning high-priced fuel and allowing this waste to go on day by day just because your boiler efficiency is marred by scale? Prevent it.

DEARBORN FEED WATER TREATMENT has proved to be an effective remedy for such troubles.

By keeping the tubes and sheets free from scale, Dearborn Treatment makes every shovelful of coal yield its utmost value. In medium cases it will save enough fuel to pay for itself many times over every year.

Dearborn Treatment also prevents corrosion and all other boiler troubles due to impurities in the Feed Water.

Send us a gallon of Feed Water We will analyse it and let you know the cost of this treatment worked especially for YOUR plant. ***WRITE AT ONCE***

Dearborn Drug & Chemical Works

GENERAL OFFICES AND LABORATORY **CHICAGO** | EASTERN OFFICES 299 BROADWAY **NEW YORK**

Don't fail to mention this paper in writing to advertisers.

"ECLIPSE" BOILER ENAMEL

"ECLIPSE" BOILER ENAMEL IS A THOROUGH PREVENTATIVE OF THE FORMATION OF BOILER SCALE, PITTING, CORROSION, FOAMING, ETC., IN ANY WATER.

No new scale can form in any boiler in which "Eclipse" is correctly used.

Old scale is quickly removed by its action.

WRITE FOR LIST OF USERS, THEN WRITE THEM FOR FULL INFORMATION REGARDING THE EFFICIENCY AND RELIABILITY OF THIS SERVICEABLE BOILER ENAMEL.

Write at once and LET THE USER CONVINCE YOU before you buy. His testimonial will be a great advertisement to us.

BOILER PROTECTION

In "Eclipse" Boiler Enamel we have a preparation which gives no heed to the class of water used. but in every case puts a filmy coating over the heating surfaces of the boiler, which makes it absolutely impossible for solid matter in any form to adhere to the iron. The scale-forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler in the form of a soft, soapy mud which will not burn or blister, and is most readily blown from the boiler.

OUR PROPOSITION

The following letter, which accompanies every trial shipment of "ECLIPSE" BOILER ENAMEL, speaks for itself:

Messrs..... Winnipeg.....

Gentlemen,—We have shipped you this date .....bbl. "Eclipse" Boiler Enamel, which, when used according to directions contained in our booklet, must give you entire satisfaction in your plant, otherwise you will not be required to pay for same. We leave it to your own sense of fairness to see that "Eclipse" gets a square deal. Under these conditions we are sure of the result.

"Eclipse" Boiler Enamel is guaranteed to be absolutely harmless to the boilers or the fittings. Being harmless, it is slow in its action on old scale, but it is deadly sure. Yours very truly,

Send for our booklet to-day

W. W. CARRUTHERS

388 Edmonton Street, WINNIPEG, Man.

AGENTS:—J. A. Cartwright, 616 Wellington St., London, Ont.; A. J. Chamberlain, 52 Colborne St., Toronto, Ont.; J. H. Elliott, 42 Fort St., Montreal; W. L. Magee, Middleton, N. S.

The 20th Century Shaking and Dumping Grate Bar

SHOWS RESULTS.

Saves fuel and cuts labour of stoking in half

Gives more steam and increases output of plant.

For heating boilers, power boilers, brick-kilns, gas producers, etc.

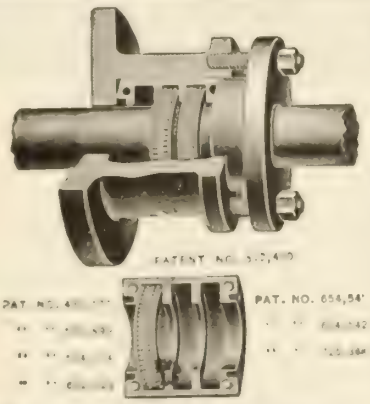
Maximum air-space, greater Dumping Capacity than any other Bar.

We supply our Grates to burn any fuel and guarantee long life and satisfactory working.

Prompt attention and expert advice cheerfully given

The Boiler Repair & Grate Bar Co.

Head Office:---69 Adelaide St. East, Toronto Phone---Main 1608



Why not Buy the Best, when in market for Packing?

HOLMES'

Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

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CANADIAN CASUALTY

AND

BOILER INSURANCE COMPANY'S

NEW BLANKET POLICY IS THE MOST LIBERAL INSURANCE CONTRACT NOW ON THE MARKET

IT COVERS ALL LOSSES TO LIFE AND PROPERTY

INCLUDES HIGH CLASS INSPECTIONS AND ENGINEERING ADVICE

CONTINENTAL LIFE BUILDING
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Phone Main 6941.

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BOILER COMPOUNDS

Save Labor, Time and Fuel

They are compounded on purely scientific principles, and we use only the best grade of chemicals obtainable, which are prepared in powder form.

We guarantee that our Compound can be used with safety where live steam comes in direct contact with the goods manufactured, such as Breweries, Lard Manufactories, Dye Houses, etc , etc., and will prevent any tendency toward priming or foaming · also that "WALSH" Boiler Compounds will remove every particle of scale without the slightest injury to the tubes: that the same action will prevent corrosion and pitting

Send us a sample of scale (about two ounces) or half a gallon of FEED WATER before ordering.

By doing this we can best meet your requirements, and give you prices in proportion to strength of compound.

Mr. Engineer, if you would like a nice hat send us your size and we will forward you one FREE.

THE WALSH CHEMICAL COMPOUNDING CO.,
67 Bay St. North, Hamilton, Ont.

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QUALITY

Counts in

Gauge Glasses

Bishops
ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

ADAMANT
GLASSES

have been tested under all conditions and have proved their superiority over all others.

Write us for Further Particulars

J. R. Baxter & Co.

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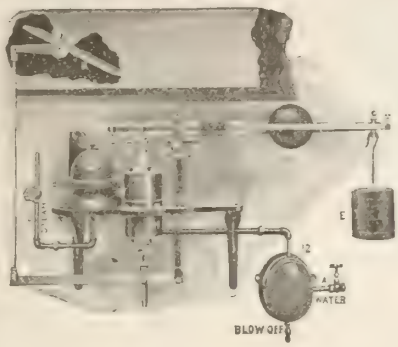
Regulate Your Dampers



WITH A

Stillman-Carmichael Damper Regulator.

The SAVING effected in FUEL by the installation of this Regulator will vary from 5 to 18% and the first cost is very small.

It will REGULATE High and Low pressure STEAM BOILERS, Blowers and Pumping Engines.

One Regulator will govern one or more Boilers. It will close or open wide the damper or dampers on a variation of ONE POUND of STEAM.

We furnish these Regulators subject to 30 days' trial.

Darling Brothers, Ltd.

125 Prince Street - MONTREAL, P.Q.

Winnipeg, Man. St. John, N.B. Toronto, Ont.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

W. A. CROCKETT

Executive Secretary

MT. HAMILTON, - - ONTARIO

The "OTIS"

TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER

is a Heater that is built on correct up-to-date principles, and for the purpose of reducing fuel bills.

The steam that would otherwise go to waste can be used economically by allowing it to pass through the Heater, therefore keeping your Feed Water at boiling point.

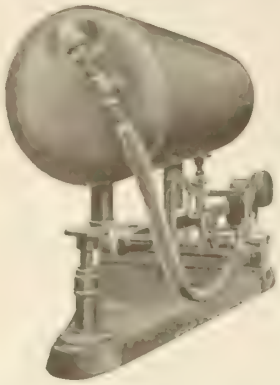
The "OTIS" Heater does its work rapidly, and is built to withstand hard usage. It has no parts that are liable to get out of order.

The exhaust steam after passing through this heater can be used for further heating purposes if desired, as it extracts the oil from the exhaust.

Write for our catalog.

The Stewart Heater Co.

189 Norfolk Ave., Buffalo, N.Y., U S.A.



The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

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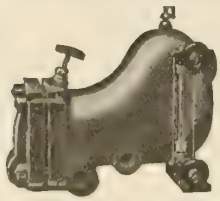
Canadian Representatives—Geo. W. Cole, c/o A. R. Williams Machinery Co., Toronto, Ont.; W. H. Markle, Montreal; Park Bros., Chatham, Ont.; W H Rosevear & Son, Winnipeg, Man.

WAINWRIGHT WATER HEATERS

A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS are designed specially to fulfill the requirements of Bleacheries, Dyehouses, Paper Mills, Laundries

ALBERGER CONDENSOR CO.
140 Cedar Street, NEW YORK CITY
Agents: CANADIAN FAIRBANKS CO., Limited
Montreal, Toronto, Winnipeg, Vancouver



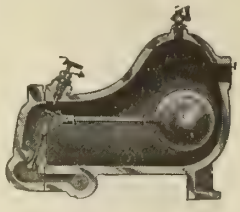
McDANIEL IMPROVED **STEEL TRAP**

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

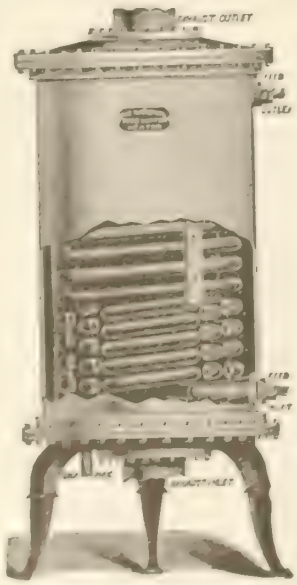
Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, ONT.

National Feed Water Heater



The simplicity of the National Feed Water Heater has made it a favorite in many of the best equipped engine rooms on the continent.

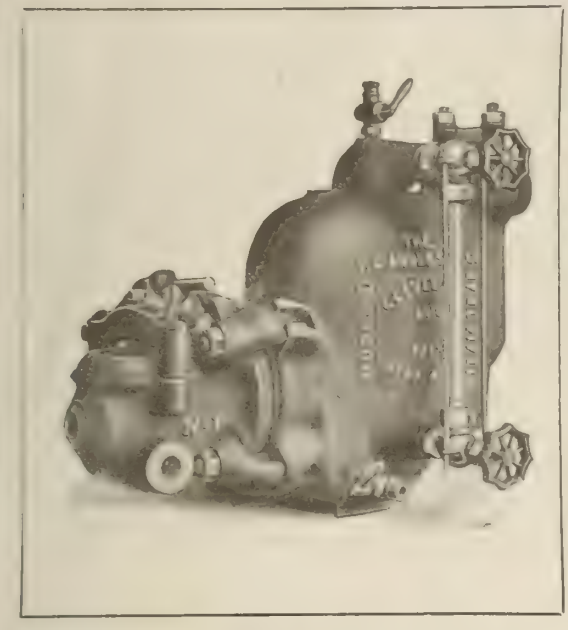
The Feed Water never comes in contact with the shell, an at no time is the shell subject to boiler pressure, consequently corrosion or leakages are impossible.

Coils of seamless drawn brass or copper tubing, passing through a shell of cast iron or steel, carry the Feed Water, Exhaust Steam admitted to the Shell, heats the water in the tubes.

WRITE FOR CATALOG ON THIS CERTAIN FUEL SAVER

The National Pipe Bending Co.
91 Lloyd Street
NEW HAVEN : CONN. : U.S.A.

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

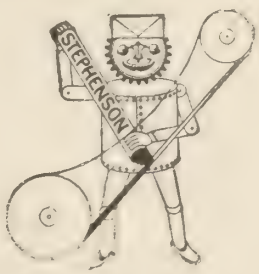
Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

HAVE YOU WRITTEN for a Free Half-pound Bar of Stephenson Bar Belt Dressing? This bar is large enough to give a convincing trial and is often an introduction to initial orders. After the first order the others follow as a matter of course.

The genuine Stephenson Bar Belt Dressing always bears this trade mark:



This dressing has been on the market for nearly twenty-five years and is an established article. It is carried by the prominent dealers of Canada.

Write us to-day for a Free Half-pound Sample.

STEPHENSON MANUFACTURING CO.

ALBANY - - NEW YORK

Tight Belts Invariably Mean Loss

Prof. Thurston says that the power loss in mills and shops ranges from 5 to 70 per cent. Tests made by a prominent cotton mill engineer and quoted in Kent's Mechanical Engineers' Pocket-Book showed that in eight modern mills with first-class shafting, the power required to run the shafting alone ranged from 25 to 39 per cent. of the total. Commenting upon these figures this engineer is further quoted as follows:

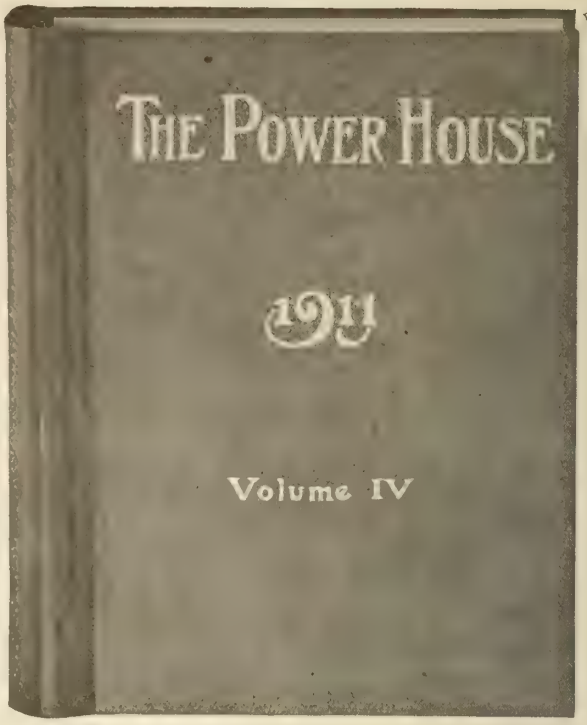
> "These may be taken as a fair showing of the power that is required in many of our best mills to drive shafting. It is unreasonable to think that all the power is consumed by a legitimate amount of friction of bearings and belts. I know of no cause for such a loss of power but tight belts. I believe three-quarters of the trouble experienced in broken pulleys, hot boxes, etc., can be traced to the fault of tight belts. The enormous and useless pressure thus put upon pulleys must in time break them, if they are made in any reasonable proportions, besides wearing out the whole outfit, and causing heating and consequent destruction of the bearings."

The above unbiased statements should receive serious attention. Prevention of slip by applying Cling-Surface to the belts is economical, because Cling-Surface renders the initial tension unnecessary. Constant systematic Cling-Surface treatment lubricates and mellows the interior of the belt, makes the surface soft, clean and clinging. By increasing its flexibility and helping its surface to conform better to the pulley face, Cling-Surface makes a belt work so much better than tension does that the belt will break before slipping. Hence belts treated with Cling-Surface may be slackened and the pulley contacts increased in some instances until the loose half of the belt (when on top) almost touches the working half.

Use Cling-Surface at our risk. Write for literature.

Cling-Surface Co

1057 Niagara Street - Buffalo N Y



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Distinguishes

D.K.McLAREN'S

Genuine British Oak-Tanned

LEATHER BELTING

from all inferior grades now on the market

Mr. Engineer, before placing your order for Belting, look up the past and present record of **D. K. McLaren's Genuine British Oak-Tanned Leather Belting.**

Write us for testimonials, and let the user convince you of its quality.

This Belting cannot be excelled for dependability, as we use only the best centres, tanned by the genuine British Oak Tanning process.

Our long experience in Leather Belt manufacture enables us to produce a Belting that can be absolutely relied upon to transmit the maximum power with certainty, and to stretch less than any brand manufactured.

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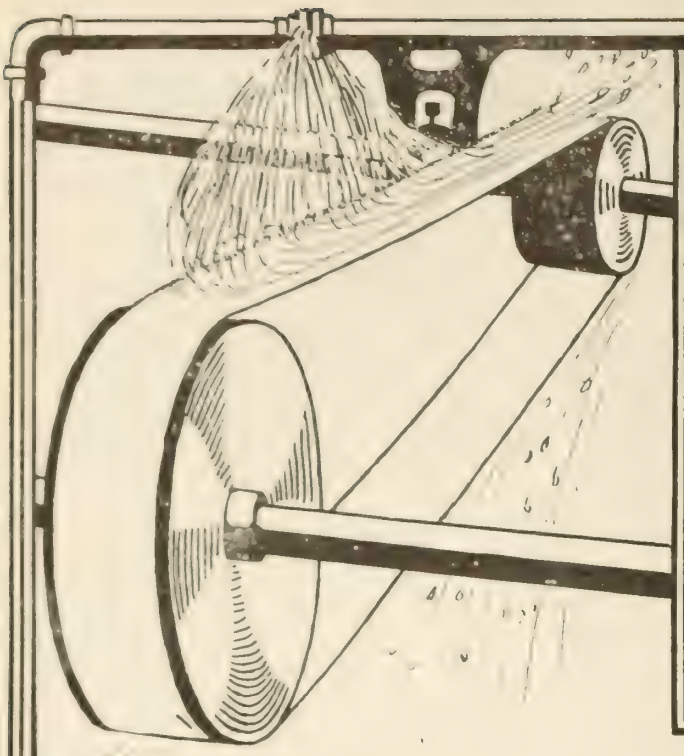

"AMPHIBIA" WATERPROOF LEATHER BELTING

When buying "AMPHIBIA" waterproof Leather Belting you receive a written guarantee that it is absolutely waterproof, and will not deteriorate under the most exacting conditions.

The reason we offer such a broad guarantee is that it has been submitted to every test, and we have every process under the most rigid supervision, from the selection of the hides to the finishing of the Belt, and have every proof of "AMPHIBIA" to give long, reliable service everywhere.

We have "AMPHIBIA" Beltings to meet every requirement as follows:

"AMPHIBIA" WATERPROOF BELTING could be used under water without harming it in any way.

"AMPHIBIA" Heavy Single is made for extra heavy work from very thick leather.

"AMPHIBIA" Light Double will take moderate power over small pulleys.

"AMPHIBIA" HEAVY DOUBLE is the giant belt intended for heavy mill work.

"AMPHIBIA" Planer for the particular work on wood planers.

"AMPHIBIA" Special Laundry for the wash wheels.

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For 34 years the Makers of the Best Belts

MONTREAL, 511 William Street — TORONTO, 27 Melinda Street

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☞ TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN ☜

Reliable and Efficient
Power Transmission

The "CAMEL HAIR" Brand Belting will last longer, stretch less, and transmit more power than any belt manufactured.

Service has proved that it has strength that is greater than double Leather Belting that is manufactured.

"CAMEL HAIR" Brand Belting is more reliable, more efficient, and lower in cost than any other. W H Y ?

Because ! It has no plys to open up and fall apart.
Because ! It has no rubber or gum to heat and peel.
Because ! It lasts longer than any other belt on the market.
Because ! It slips just one-half that of any other belting.
Because ! It will run equally well in damp, wet, or a dry atmosphere.
Because ! It is less affected by acid fumes and high temperatures than any other Belting.
Because ! It is uniform in thickness and runs true.
Because ! Of its great strength---almost twice that of best oak-tanned double leather.
Because ! It requires much less attention than other styles of Belting.
Because ! The stretch comes out quickly, and after taking up once or twice (according to load and nature of run) requires little or no more attention.
Because ! It transmits more power than any other Belting.

Beware of Imitations

We have many imitators---which proves the superiority of "CAMEL HAIR" Brand Belting

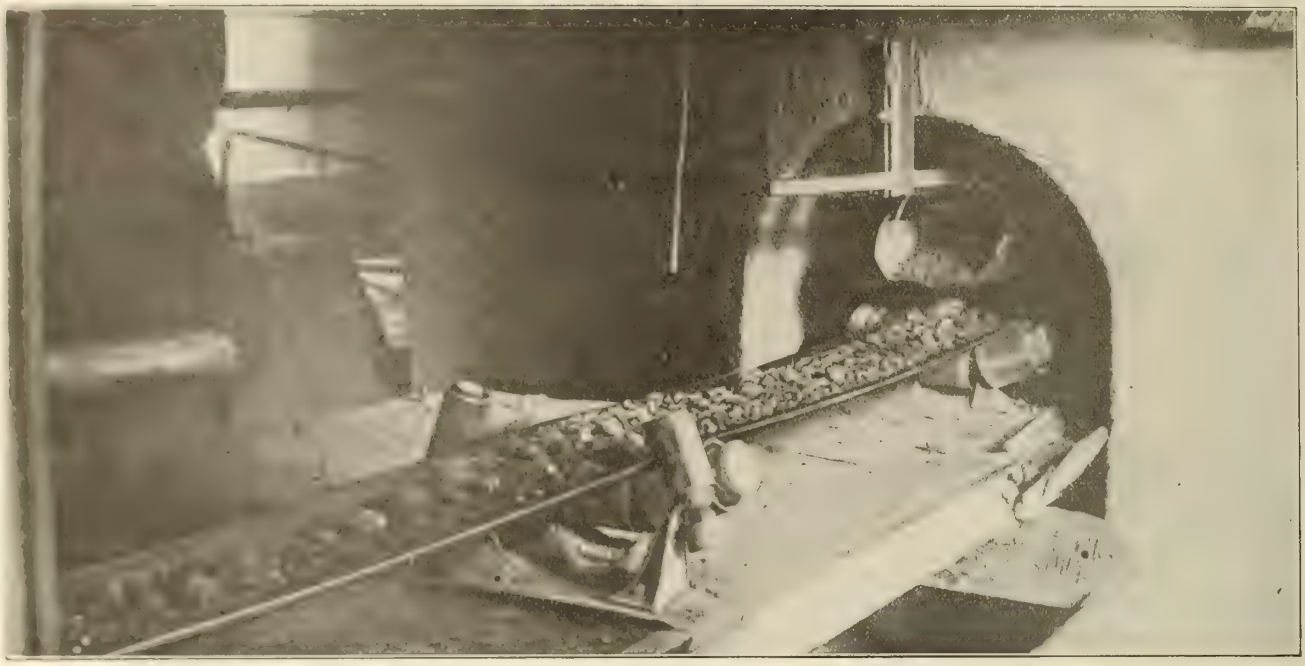
Write for full particulars and prices---if taken seriously they will increase your trade.

F. REDDAWAY & CO.

Sole Manufacturers

56 St. Francois Xavier Street : : MONTREAL, QUE.

THE NEW "LEVIATHAN" CONVEYOR BELT. Conveying Clinker Rock, High Temperature.



A decided improvement over any belt now used for conveying purposes.

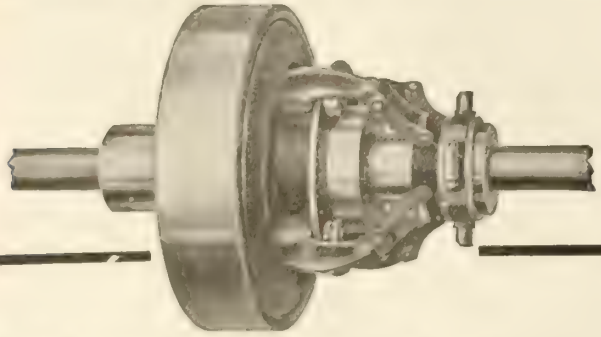
The new black composition which we have perfected impregnates and coats every fibre, making the entire belt water-proof, acid-proof and capable of standing high temperatures.

Further protection is afforded the fibres of this New "Leviathan" by an added coating of the new composition on the carrying side of the belt.

The whole belt is a superior belt—heavier, lasts longer, carries more material, and requires less attention than the belts in general use.

Main Belting Company of Canada, Limited

MONTREAL and TORONTO



THE SAFEGUARD

If, because of several recent burglaries in your neighborhood, you had decided to install burglar alarms on your doors and windows, you wouldn't put them on all the windows but one, and that one a back window in a secluded nook where thieves might be most apt to break in and steal your money. Why should you make the same mistake in buying clutches?

Your primary reason for purchasing clutches is to safeguard your power—your money—to shut off idle machines or groups of machines and prevent them from robbing you. But there is that "back window in the secluded nook" where, if you only knew it, more of your power can be appropriated than the saving in control can offset and that is while driving with ordinary slipping friction clutches.

There is but one clutch that absolutely safeguards all your power - your money—the POSITIVE Combined Jaw and Friction Clutch. The Jaws do the work and they are positive. Therein lies The SAFEGUARD.

The Positive Clutch & Pulley Works, Limited

Eastern Representatives and Warehouse
CANADA FORD CO., Ltd., MONTREAL, P.Q.

TORONTO, ONT.

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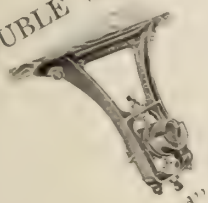
BUFFALO, N.Y.

The advertiser would like to know where you saw his advertisement—tell him.

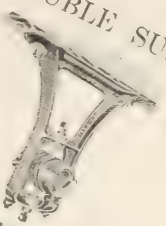
Make Assurance "DOUBLE SURE"
and Take a Bond.

DOUBLE SURE



The "Bond" Patent Shaft Hanger

DOUBLE SURE



The "Bond" Patent Shaft Hanger

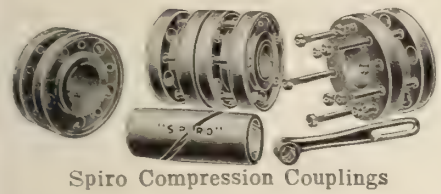
Universal Ball and Socket Ring Oiling Hangers

All Bearings Babbitted and Reamed

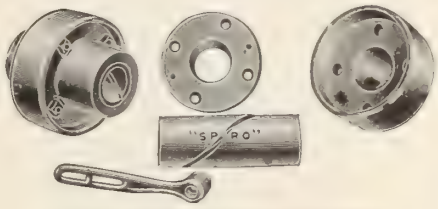
SPIRO
Compression Couplings
50%

More Gripping Power Than Any Other Coupling on the Market.

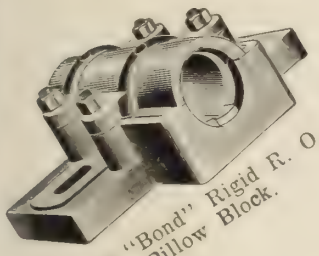
Send for Complete Catalogue "Y"



Spiro Compression Couplings



Spiro Compression Couplings



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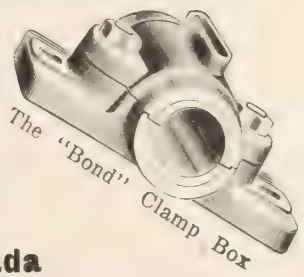

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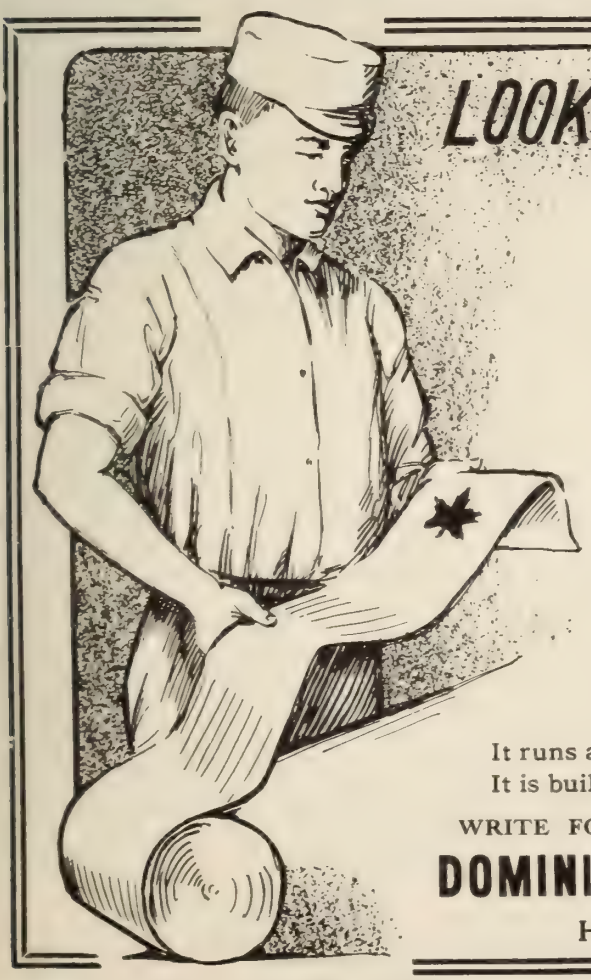

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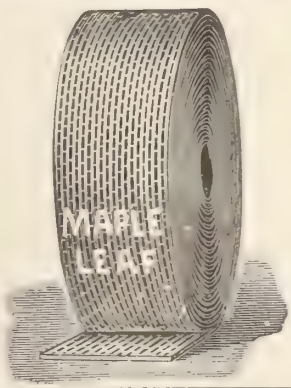

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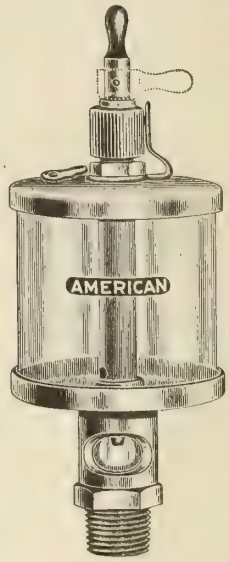

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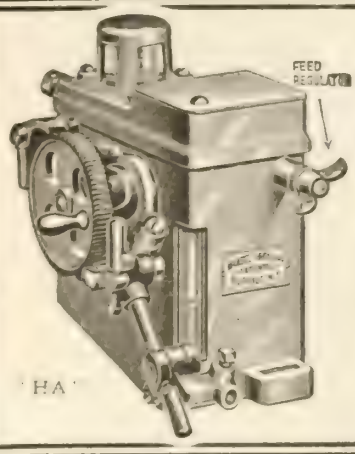

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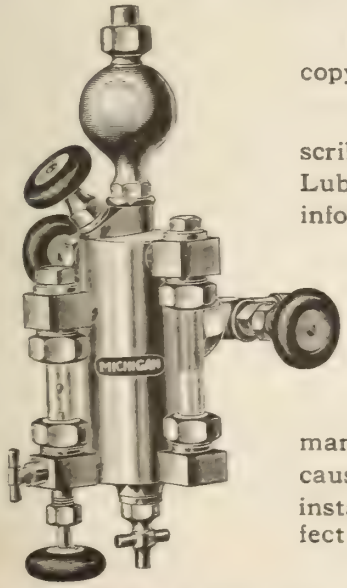

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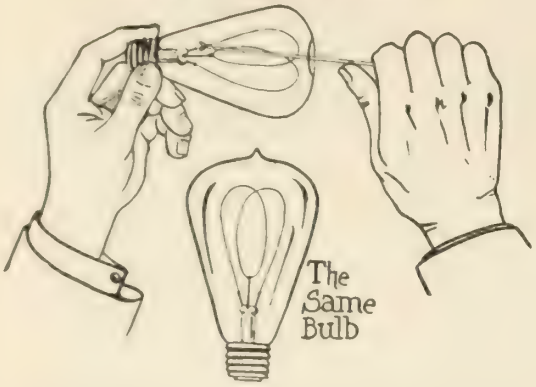

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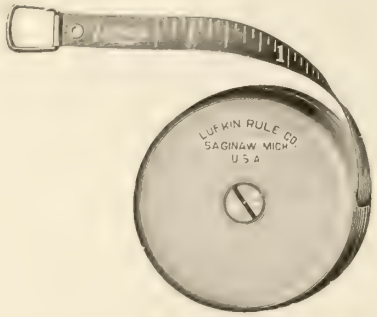

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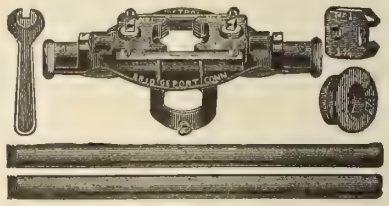

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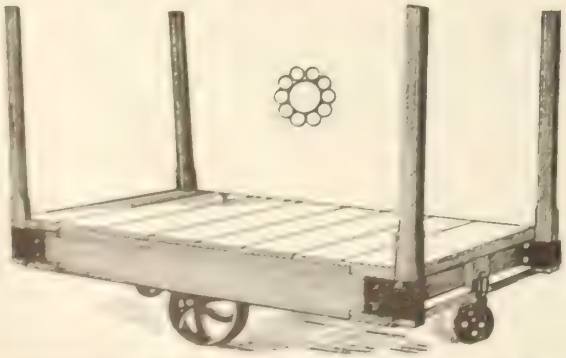

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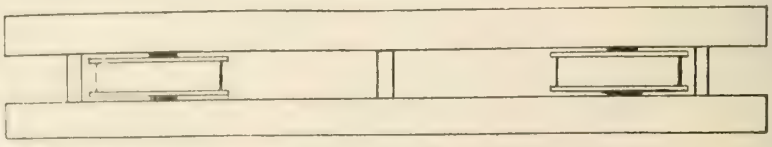

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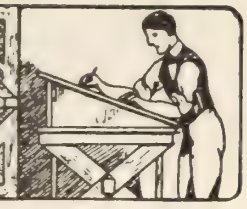

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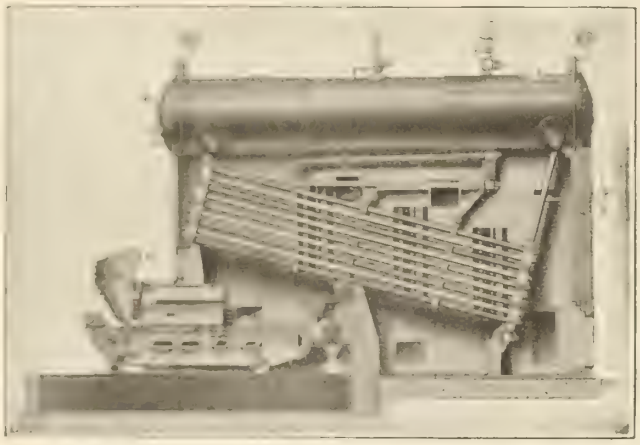

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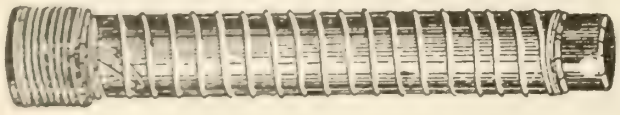

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Canadian Fairbanks Co., Ltd., Montrea
Michigan Lubricator Co., Detroit
Morehead Mfg. Co., Detroit, Mich.
Standard Eng. Co., Toronto

Boiler Feed Pumps.

American Steam Pump Co. Battle Creek Mich.
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
Deming Co., Salem, O.
C. A. Dunham Co., Ltd., Toronto
General Supply Co. of Canada, Ottawa
Power Economies, Ltd., Montreal
Standard Eng. Co., Toronto

Boiler Feed Regulators.

Canadian Fairbanks Co., Ltd., Montreal
General Supply Co. of Canada, Ottawa
Heat & Pressure Control Co., Toronto
H. L. Peiler & Co., Montreal
Power Economies Ltd., Montreal
Standard Engineering Co., Toronto
Watts Regulator Co., Lawrence, Mass.

Boiler Mountings.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
Darling Bros., Montreal
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal

Boiler Settings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Boiler Tube Cleaners.

Garlock Packing Co., Hamilton, Ont
The Paul B. Huyette Co., Philadelphia
Liberty Mfg. Co., Pittsburg
Michigan Lubricator Co., Detroit
H. L. Peiler & Co., Montreal
Wm. B. Pierce Co., Buffalo, N.Y.
Power Economies, Ltd., Montreal
Worcester Brush & Scraper Co., Worcester, Mass.
Vulcan Tube Cleaning Systems, Limited Montreal

Boilers, Horizontal, Tubular and Watertube.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Canada Foundry Co. Ltd., Toronto
General Supply Co. of Canada, Ottawa
Jenckes Machine Co., Sherbrooke, Que.
Jones Underfeed Stoker Co., Montreal.
E. Leonard & Sons, London, Ont
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.
The Wm. Hamilton Co., Peterborough

Boilers, Marine, Locomotive and Vertical.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Canada Foundry Co., Ltd., Toronto
The Wm Hamilton Co., Peterborough.
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Buckets.

Manitoba Bridge & Iron Works Limited, Winnipeg

Cables, Aerial and Underground.

Eugene F. Phillips Electrical Works, Ltd., Montreal

Car Movers and Pullers.

Manitoba Bridge & Iron Works Limited, Winnipeg

Cast Iron Fittings.

General Supply Co. of Canada, Ottawa

Castings, Brass and Iron.

Corbet Foundry and Machine Co., Ltd., Owen Sound
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit

Cement, Fireproof.

Canadian H. W. Johns-Manville Co Ltd., Toronto

Cement Machinery.

Canadian Fairbanks Co., Ltd., Montreal

Chemicals.

Dearborn Drug and Chemical Works Chicago
C. C. Snowdon, Calgary

Circuit-Breakers.

Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton

Clutches.

Elmira Machinery and Transmission Co., Elmira
General Supply Co. of Canada, Ottawa
Manitoba Bridge & Iron Works Limited, Winnipeg
Positive Clutch & Pulley Works, Toronto

Coal and Ash Conveyors.

Babcock & Wilcox, Montreal
H. L. Peiler & Co., Montreal
Standard Eng. Co., Toronto

Coal Handling Machinery

Standard Engineering Co., Toronto

Cold Storage Architects.

E. J. Greenstreet, Toronto

Cold Storage Insulation.

Canadian H. W. Johns-Manville Co., Ltd., Toronto

Condensers.

Alberger Condenser Co., New York
American Steam Pump Co., Battle Creek Mich.
Canada Foundry Co., Ltd., Toronto
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
H. L. Peiler & Co., Montreal
Standard Eng. Co., Toronto

Conduits.

E. Leonard & Sons, London, Ont

Consulting Engineers.

Bayfield & Archibald, Vancouver, B.C.
de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
John T. Farmer, Montreal
Walter J. Francis, Montreal.
E. J. Greenstreet, Toronto
Laurie & Lamb, Montreal
Moore & Scollan, Toronto
John B. McRae, Ottawa
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.
Standard Engineering Co., Toronto

Contractors, Structural Steel

Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto

Conveyor Machinery.

Canadian Fairbanks Co., Ltd., Montreal

Cooling Towers

Alberger Condenser Co., New York

Cork Insulation.

Canadian Fairbanks Co., Ltd., Montreal
Linde British Refrigeration Co., Montreal

Cotton Hose.

Garlock Packing Co., Hamilton, Ont
Quaker City Rubber Co., Philadelphia, Pa.

Couplings.

Canadian Bond Hanger & Coupling Co., Alexandria Ont.
Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
Elmira Machinery and Transmission Co., Elmira
General Supply Co. of Canada, Ottawa
Manitoba Bridge & Iron Works Limited, Limited

Cranes, Electric.

Babcock & Wilcox, Montreal
Canada Foundry Co., Ltd., Toronto

Crank and Crosshead Pin Oilers.

Corbet Foundry and Machine Co., Ltd., Owen Sound
Michigan Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio

Crushing Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
The Wm. Hamilton Co., Peterborough

Damper Regulators.

Darling Bros., Montreal
Elliott Co., Pittsburgh, Pa.
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Standard Eng. Co., Toronto
Watts Regulator Co., Lawrence, Mass.

Drying Machinery.

Canadian Fairbanks Co., Ltd., Montreal

Dynamos.

Canadian Fairbanks Co., Ltd., Montreal
Canadian General Electric Co., Ltd Toronto
Canadian Westinghouse Co., Hamilton

Economizers.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal

Electric Fans.

Canadian General Electric Co., Ltd., Toronto

Electrical Accessories and Machinery.

Canadian Fairbanks Co., Ltd., Montreal,
Canadian General Electric Co., Ltd. Toronto
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto
General Machinery Co., Toronto
Kilmer, Pullen & Burnham, Ltd., Toronto
Northern Electric & Mfg. Co., Limited, Montreal

Elevating Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Engines, Automatic and Drop Valve.

Douglas & Grant, Kirkaldy, Scotland
E. Leonard & Sons, London, Ont
Robb Engineering Co., Amherst, N.S.

Engines, Corliss and Rocking Valve.

Douglas & Grant, Kirkcaldy, Scotland.
Goldie & McCulloch, Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont
Robb Engineering Co., Amherst, N.S.

Engines. Gas and Gasoline.

Canada Foundry Co., Ltd., Toronto
[illegible] Barrie, Ont.
[illegible] Westinghouse Co., Hamilton
[illegible] Toronto
[illegible] Ottawa
[illegible] America
[illegible]
E. Leonard & Sons, London, Ont.

Engines. Hauling and Winding.

[illegible] & Grant, Kirkcaldy, Scotland

Engines. High Speed, Steam.

Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
Power Economies, Ltd., Montreal
[illegible] Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines Marine

Canadian Fairbanks Co., Ltd., Montreal
[illegible] Ottawa
E. Leonard & Sons, London, Ont.

Engines Saw Mill.

[illegible] & McCulloch Co., Galt
The Wm. Hamilton Co., Peterborough.
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines. Single. Compound and Triple Expansion.

Fadie-Douglas, Ltd., Montreal
The Wm. Hamilton Co., Peterborough.
Jenckes Machine Co., Sherbrooke, Que.
[illegible] & Grant, Montreal
E. Leonard & Sons, London, Ont.
Kerr Engine Co., Walkerville
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines Vertical.

International Harvester Co. of America
[illegible]
[illegible] Ottawa
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.

Engine Stops.

Power Economies, Ltd., Montreal

Exhaust Fans.

[illegible] Ottawa
[illegible] Montreal
[illegible] Ltd., Montreal
Standard Eng. Co., Toronto

Exhaust Heads.

Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Fadie-Douglas, Ltd., Montreal
[illegible] Pittsburgh, Pa.
Standard Engineering Co., Toronto.
Wm. [illegible] & M. Dowdell Co., Philadelphia

Expansion Joints

Alberger Condenser Co., New York

Feed Water Alarms.

H. L. Peiler & Co., Montreal

Feed Water Analyser.

[illegible] Drug and Chemical Works, Chicago
C. C. Snowdon, Calgary

Feed Water Heaters

[illegible] New York
Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
[illegible] Equipment Co., Toronto
Darling Bros., Montreal
Fadie-Douglas, Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
[illegible] Ottawa
[illegible] Montreal
The Wm. Hamilton Co., Peterborough.
[illegible] New Haven, Conn.
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
[illegible] Amherst, N.S.
Standard Engineering Co., Toronto
The [illegible] N.Y.

Feed Water Regulators

[illegible] Ltd., Toronto
[illegible] Pittsburgh, Pa.
H. L. Peiler & Co., Montreal
[illegible] Montreal
[illegible]
[illegible] Lawrence, Mass.

Filters, Pressure

[illegible] Canada, Toronto
Fadie-Douglas, Ltd., Montreal

Feed Water Filters.

[illegible] New York
[illegible] Canada, Toronto
[illegible]
[illegible] Ltd., Montreal

Fine Wire Brushes.

Worcester Brush & Scraper Co., Worcester, Mass.

Fire Hose.

Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick.

Alex. Gibb, Montreal
Harbison-Walker Refractories Co., Pittsburg, Pa.

Flanges

Dart Union Co., Toronto
General Supply Co. of Canada, Ottawa

Flue Brushes.

General Supply Co. of Canada, Ottawa
Worcester Brush & Scraper Co., Worcester, Mass.

Flumes, Steel.

Canada Foundry Co., Ltd., Toronto
Corbet Foundry and Machine Co., Ltd., Owen Sound
The Wm. Hamilton Co., Peterborough
E. Leonard & Sons, London, Ont.

Furnace Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.
Standard Eng. Co., Toronto

Fuses.

Canadian H. W. Johns-Manville Co., Ltd., Toronto
Canadian General Electric Co., Limited, Toronto

Gaskets, Asbestos and Copper.

American Goetze-Gasket & Packing Co. New Brunswick
Asbestos & Rubber Goods Co., Toronto
Canadian H. W. Johns-Manville Co. Ltd., Toronto
Garlock Packing Co., Hamilton Ont.
General Supply Co. of Canada Ottawa

Gas Producer Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Gas Exhausters

Standard Eng. Co., Toronto

Gas Producer Plants.

Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co. Ltd., Toronto
Canadian Westinghouse Co., Hamilton
E. Leonard & Sons, London, Ont

Gauge Cocks.

American Lubricator Co., Detroit
Canadian Fairbanks Co., Ltd., Montreal
General Supply Co. of Canada Ottawa
Lunkenheimer Co., Cincinnati, Ohio
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Standard Eng. Co., Toronto

Gauge Glass Cutters.

Worcester Brush & Scraper Co. Worcester, Mass.

Gauge Glasses.

J. R. Baxter & Co., Montreal
W. J. Wall, Montreal
Garlock Packing Co., Hamilton, Ont

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Babcock & Wilcox, Montreal
C. A. Dunham Co., Ltd., Toronto
Fadie-Douglas, Ltd., Montreal
Lunkenheimer Co., Cincinnati, Ohio
H. L. Peiler & Co., Montreal

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The Wm. Hamilton Co., Peterborough

Gears, Cut, Worm, Mortise.

J. R. Baxter & Co., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
The Wm. Hamilton Co., Peterborough

Gears, Spur Level.

Corbet Foundry and Machine Co., Ltd., Owen Sound
Manitoba Bridge & Iron Works Limited, Winnipeg

Generators.

Canadian Fairbanks Co., Ltd., Montreal
Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
[illegible] Toronto
Northern Electric & Mfg. Co., Limited, Montreal

Graphite.

Jos. Dixon Crucible Co., Jersey City
[illegible] Ottawa
C. C. Snowdon, Calgary

Grates.

Babcock & Wilcox, Montreal
Boiler Repair & Grate Bar Co., Toronto
Canadian Steam Boiler Equipment Co., Toronto
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Standard Eng. Co., Toronto

Grease Cups.

American Lubricator Co., Detroit
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada Ottawa
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peterboro Lubricator Co., Peterboro, Ont
Power Economies, Ltd., Montreal

Grease and Oil Extractors.

Canada Foundry Co., Ltd. Toronto
Fadie-Douglas Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
Power Economies, Ltd., Montreal
C. C. Snowdon, Calgary
Standard Eng. Co., Toronto

Greases

Canadian Fairbanks Co., Ltd., Montreal
Jos. Dixon Crucible Co., Jersey City
Power Economies, Ltd., Montreal
C. C. Snowdon, Calgary

Hangers.

Canadian Band Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
Elmira Machinery and Transmission Co., Elmira
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Positive Clutch & Pulley Works, Toronto
Waterous Engine Works Co., Brantford
The Wm. Hamilton Co., Peterborough

Heaters.

Alberger Condenser Co., New York
Darling Bros., Montreal
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough
E. Leonard & Sons, London, Ont.
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Standard Eng. Co., Toronto
The Stewart Heater Co., Buffalo, N.Y.

Hose Fittings.

Power Economies, Ltd., Montreal

Hose Steam.

Asbestos & Rubber Goods Co., Toronto
Dunlop Tire & Rubber Goods Co., Toronto
Garlock Packing Co., Hamilton Ont.
Power Economies, Ltd., Montreal

Hydraulic Accumulators.

Canada Foundry Co., Ltd., Toronto

Hydraulic Machinery

The Deming Co., Salem, O

Ice Making Machinery.

Linde British Refrigeration Co., Montreal

Index Cocks.

American Lubricator Co., Detroit

Indicators, Electric—All Types.

Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton

Indicators, Steam Engine.

Canadian Fairbanks Co., Ltd., Montreal
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal

Indicators, Water.

Detroit Lubricator Co., Detroit

Injectors.

Canada Foundry Co., Ltd., Toronto
Detroit Lubricator Co., Detroit
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, Ohio
Jas. Morrison Brass Mfg. Co., Toronto
Penberthy Injector Co., Windsor.

Iron Filler.

Imperial Waste & Metal Co., Montreal

Lamps, Tungsten, etc

Canadian General Electric Co., Ltd., Toronto
Canadian Tungsten Lamp Co., Limited Hamilton

Lamps, Arc, Incandescent.

Canadian General Electric Co., Ltd., Toronto
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal

Lubricants.

Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

Lubricators, Elevator Guide.

Power Economies, Ltd., Montreal

Lubricators, Force Feed.

Darling Bros., Montreal
Detroit Lubricator Co., Detroit
General Supply Co. of Canada Ottawa
Lunkenheimer Co., Cincinnati
Manzel Bros Co., Buffalo, N.Y.
Michigan Lubricator Co., Detroit
Power Economies, Ltd., Montreal
Richardson-Phenix Co., Milwaukee, Wis.
Twin City Oil Co., Berlin, Ont.

Lubricators, Plain.

Detroit Lubricator Co., Detroit
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, Ohio

Lubricators, Steam, Gas Engine.

American Lubricator Co., Detroit

Maple Cogs.

The Wm. Hamilton Co., Peterborough

Mats.

Dunlop Tire & Rubber Goods Co., Toronto

Mechanical Stokers.

Babcock & Wilcox, Montreal
Standard Engineering Co., Toronto

Meters, Electric

Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton

Meters, Water

H. L. Peiler & Co., Montreal

Mill and Mining Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd. Owen Sound
Douglas & Grant, Kirkcaldy, Scotland
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough
E. Leonard & Sons, London, Ont
Jenckes Machine Co., Sherbrooke, Que.
Madison Williams Mfg. Co., Lindsay, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Motors.

Canadian Fairbanks Co., Ltd., Montreal
Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Fadie-Douglas, Ltd. Montreal
Kinmer, Pullen & Burnham, Toronto
Northern Electric & Mfg. Co., Limited, Montreal

Motor Starters and Controllers.

Canadian General Electric Co., Ltd. Toronto
Canadian Westinghouse Co., Hamilton

Oilers, Gang.

Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis.

Oilers, Multiple.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio

Oil Cups.

American Lubricator Co., Detroit

Oil Filters

Canadian Oil & Waste Saving Machine Co., Ltd., Brockville
Darling Bros., Montreal
Fadie-Douglas, Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Power Economies, Ltd., Montreal
Richardson-Phenix Co., Milwaukee, Wis.

Oil Separators.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
Elliott Co., Pittsburgh, Pa.
Fadie-Douglas, Ltd., Montreal
General Supply Co. of Canada, Ottawa
Liberty Mfg. Co., Pittsburg
Power Economies, Ltd., Montreal
Standard Engineering Co., Toronto

Oils, Lubricating.

Dearborn Drug and Chemical Works, Chicago
C. C. Snowdon, Calgary

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A. H. Britton Co.

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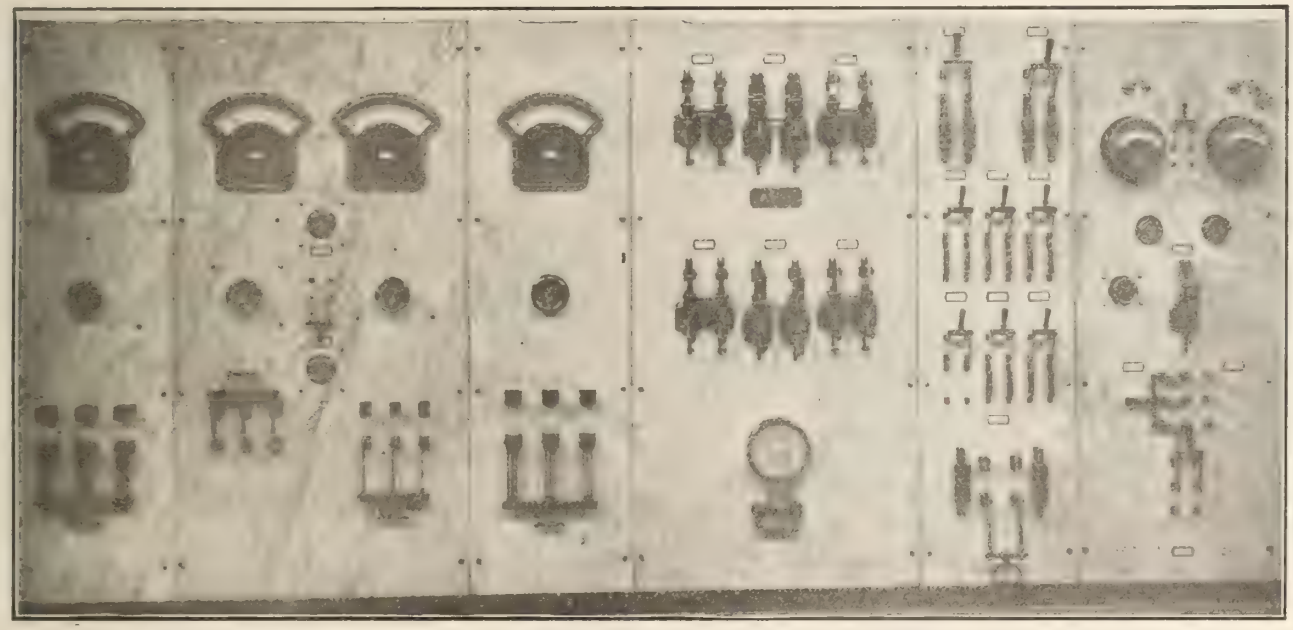

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Dunlop Tire & Rubber Goods Co , Tor-
Garlock Packing Co., Hamilton, Can.
Steel Mill Packing Co., Detroit Mich

Packing, Rod.

Dunlop Tire & Rubber Goods Co., Tor-
Garlock Packing Co , Hamilton, Can

Packing, Sheet,

Asbestos & Rubber Goods Co , Toronto
J. R. Baxter & Co , Montreal
Dunlop Tire & Rubber Goods Co., Tor-
Garlock Packing Co , Hamilton, Can

Packing, Ammonia, Steam and Water.

J. R. Baxter & Co , Montreal
Dunlop Tire & Rubber Goods Co., Tor-
Garlock Packing Co., Hamilton, Can.
Power Economies Ltd , Montreal
Steel Mill Packing Co. Detroit, Mich

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Devoe Electric Switch Co., Montreal
Hill Electric Switch Co., Montreal

Penstocks.

Corbet Foundry and Machine Co., Ltd.,

Pillow Blocks

Elmira Machinery & Transmission Co., Elmira, Ont

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National Pipe Bending Co., New Haven,

Pipe Cutting and Threading Machines and Tools.

Canadian Fairbanks Co., Ltd., Montreal

Pipe, Steel

Pipe (Second-Hand.)

Imperial Waste & Metal Co , Montreal

Pipes, Water.

Piping, Steam.

Planimeters.

Plate Work.

Canada Foundry Co , Ltd., Toronto

Polish, Metal.

Power Pumps.

American Steam Pump Co , Battle Creek Mich
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd., Toronto
Darling Bros., Montreal
Deming Co., Salem, O.
C. A. Dunham Co., Ltd , Toronto
General Machinery Co., Toronto
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Goulds Pump Co., Montreal.
E. Leonard & Sons, London, Ont.
Power Economies, Ltd., Montreal
Waterous Engine Works Co., Brantford

Power Transmission Machinery.

Canadian Bond Hanger & Coupling Co., Alexandria, Ont
Canadian Fairbanks Co., Ltd., Montreal
Elmira Machinery & Transmission Co., Elmira, Ont.
The Wm. Hamilton Co., Peterborough
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Positive Clutch & Pulley Works, Toronto
The Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford

Priming Cups.

American Lubricator Co. Detroit

Pulleys.

Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co., Ltd., Owen Sound
Elmira Machinery and Transmission Co., Elmira
General Supply Co. of Canada, Ottawa
The Wm. Hamilton Co., Peterborough
Manitoba Bridge & Iron Works Limited, Winnipeg
Positive Clutch & Pulley Works, Toronto

Pulp Mill Machinery.

Escher, Wyss & Co., Toronto
E. Leonard & Sons, London, Ont.

Pumping Machinery.

American Steam Pump Co., Battle Creek Mich
Canada Foundry Co., Ltd., Toronto
Canadian Fairbanks Co., Ltd., Montreal
Deming Co., Salem, O.
Douglas & Grant, Kirkcaldy, Scotland
General Machinery Co., Toronto
General Supply Co. of Canada, Ottawa
The Wm. Hamilton Co., Peterborough

Pump Governors and Regulators.

Canadian Steam Boiler Equipment Co. Toronto
Darling Bros , Montreal
C. A. Dunham Co., Ltd., Toronto
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
H. L. Peiler & Co., Montreal
Power Economies, Ltd., Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co. Philadelphia
Watts Regulator Co., Lawrence, Mass.

Pump Strainers.

Canadian Steam Boiler Equipment Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.
Power Economies, Ltd., Montreal

Pumps, Air.

American Steam Pump Co., Battle Creek Mich
Canada Foundry Co., Ltd., Toronto
Canadian Fairbanks Co., Ltd., Montreal
Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London, Ont
Lunkenheimer Co., Cincinnati, Ohio

Pumps, Centrifugal.

Alberger Condenser Co., New York
Canada Foundry Co., Ltd., Toronto
Deming Co., Salem, O.
Escher, Wyss & Co., Toronto
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London, Ont
Standard Eng. Co., Toronto
Terry Steam Turbine Co., New York

Pumps, Geared, Compound.

Canada Foundry Co., Ltd., Toronto
Deming Co , Salem, O.
Douglas & Grant, Kirkcaldy, Scotland
Canadian Fairbanks Co., Ltd., Montreal
E. Leonard & Sons, London, Ont

Pumps, Hydraulic, Pressure.

American Steam Pump Co , Battle Creek Mich
Canada Foundry Co., Ltd., Toronto
The Deming Co., Salem, O.

Pumps, Oil.

Deming Co , Salem, O
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis
Twin City Oil Co., Berlin

Pumps, Steam

American Steam Pump Co., Battle Creek Mich
Canadian Fairbanks Co., Ltd., Montreal
Canada Foundry Co., Ltd. Toronto
Darling Bros., Montreal
The Deming Co., Salem O.
Eadie-Douglas, Ltd , Montreal
General Machinery Co., Toronto
Goldie & McCulloch Co., Galt
E. Leonard & Sons, London, Ont
Power Economies, Ltd., Montreal

Pumps, Vacuum

Alberger Condenser Co. New York
American Steam Pump Co., Battle Creek Mich.
Canadian Steam Boiler Equipment Co., Toronto.

Pump Tank, Receiver.

American Steam Pump Co., Battle Creek Mich
Canada Foundry Co., Ltd., Toronto

Rails (Relaying.)

Imperial Waste & Metal Co., Montreal

Refrigerating Engineers.

E. J. Greenstreet, Toronto

Refrigeration Machinery.

Eadie-Douglas, Ltd., Montreal
Linde British Refrigeration Co., Montreal

Reducing Wheels.

H. L. Peiler & Co., Montreal

Rheostats.

Canadian General Electric Co., Limited Toronto
Canadian Westinghouse Co., Hamilton

Roofings — Asbestos and Wool Felt.

Canadian H. W. Johns-Manville Co., Ltd., Toronto

Rope Preservative.

Cling Surface Co , Buffalo

Rotary Converters.

Canadian Fairbanks Co., Ltd., Montreal
Canadian General Electric Co., Limited Toronto
Canadian Westinghouse Co., Hamilton

Rubber Hose.

Dunlop Tire & Rubber Goods Co., Toronto
Garlock Packing Co., Hamilton, Ont
General Supply Co. of Canada Ottawa
Liberty Mfg. Co., Pittsburgh, Pa.
Power Economies, Ltd., Montreal
Quaker City Rubber Co., Philadelphia, Pa

Rubber Specialties.

Dunlop Tire & Rubber Goods Co., Toronto

Safes.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.

Safety Valves.

Canadian Fairbanks Co., Ltd., Montreal
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, Ohio
H. L. Peiler & Co., Montreal

Sanitary Brush and Scraper.

Worcester Brush & Scraper Co., Worcester, Mass.

Shafting.

Corbet Foundry and Machine Co., Ltd., Owen Sound
Elmira Machinery and Transmission Co., Elmira
General Supply Co. of Canada. Ottawa
The Wm. Hamilton Co., Peterborough
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Manitoba Bridge & Iron Works Limited, Winnipeg
Positive Clutch & Pulley Works, Toronto
Waterous Engine Works Co., Brantford,

Shaking and Dumping Grate

Babcock & Wilcox, Montreal
Standard Engineering Co., Toronto

Smoke Consumers.

Automatic Smoke Prevention Co., Montreal
Canadian Steam Boiler Equipment Co., Toronto

Smoke Boxes, Stacks.

Babcock & Wilcox, Montreal
Canada Foundry Co., Ltd., Toronto
Corbet Foundry and Machine Co,, Ltd., Owen Sound
The Wm. Hamilton Co., Peterborough
E. Leonard & Sons, London, Ont.

Soot Cleaners.

Power Economies, Ltd., Montreal
Vulcan Tube Cleaning Systems Limited, Montreal

Special Machinery.

Canadian Fairbanks Co., Ltd., Montreal

Sprocket Chain Attachments.

Manitoba Bridge & Iron Works Limited, Winnipeg

Spur Wheels.

Canadian Fairbanks Co., Ltd , Montreal
The Wm. Hamilton Co., Peterborough

Stand Pipes, Steel.

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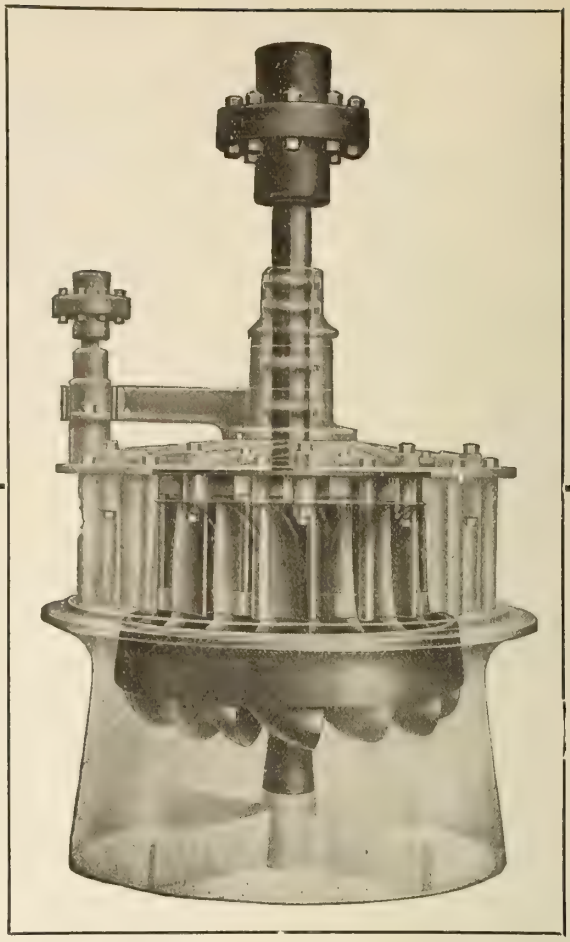

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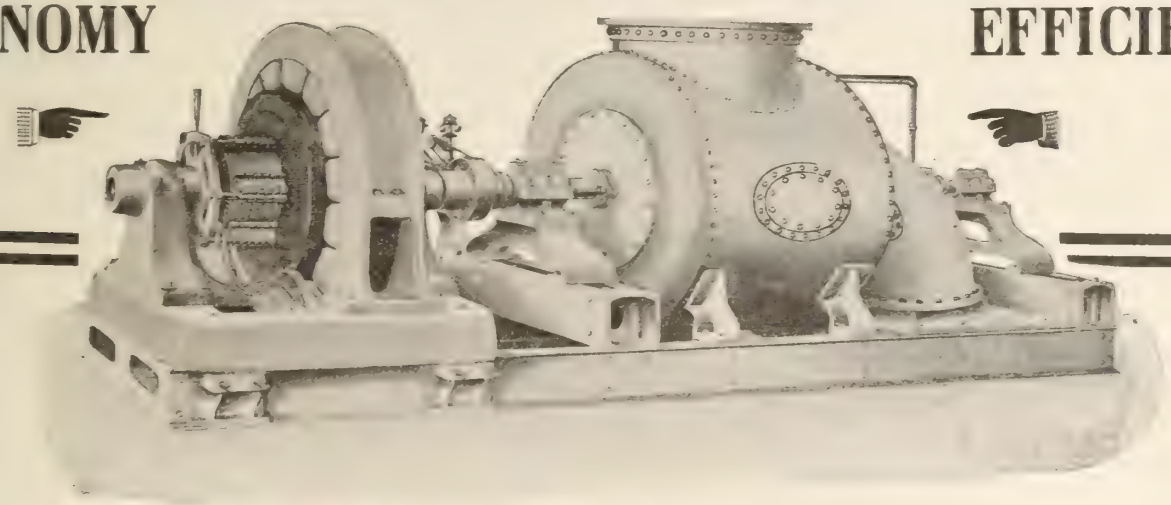

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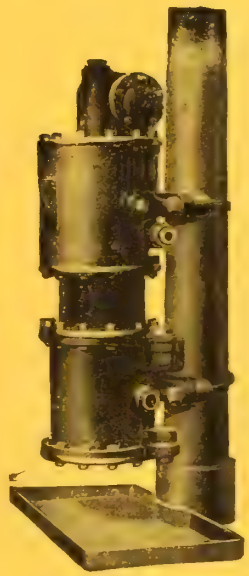

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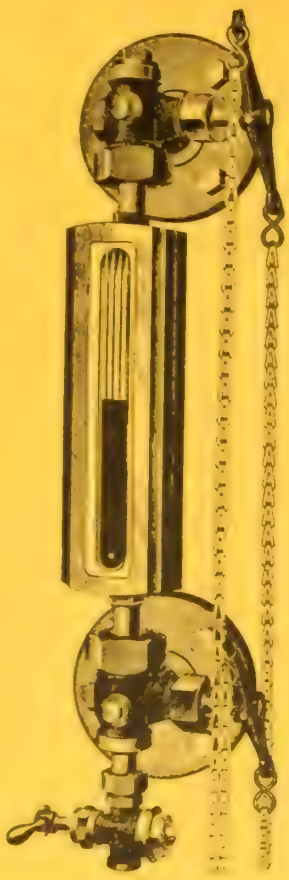

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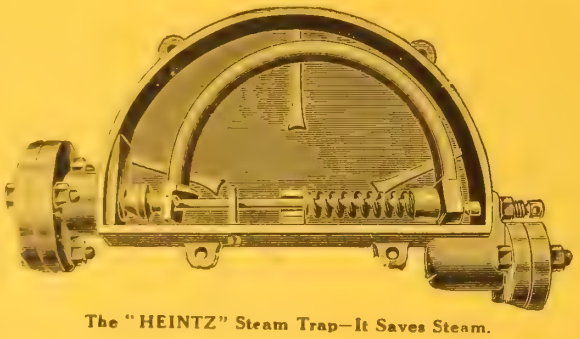

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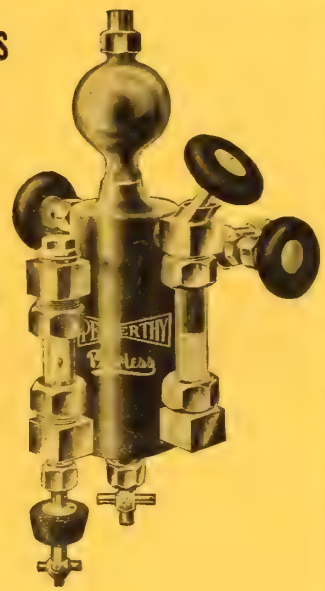

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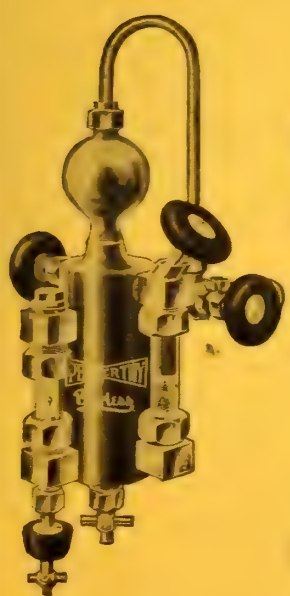

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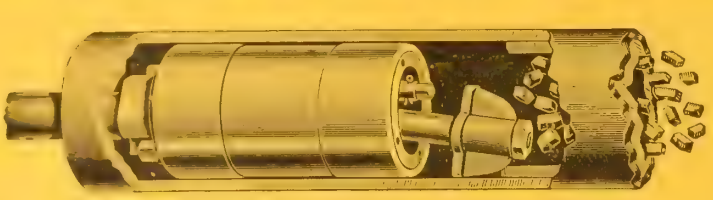

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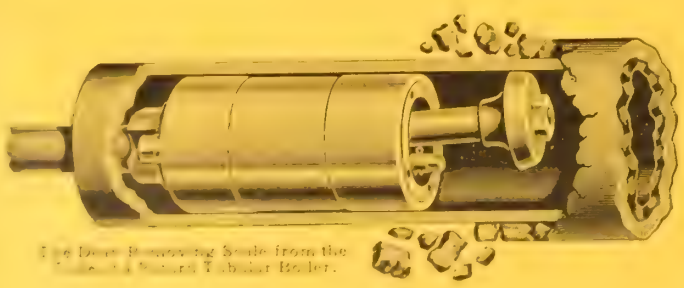

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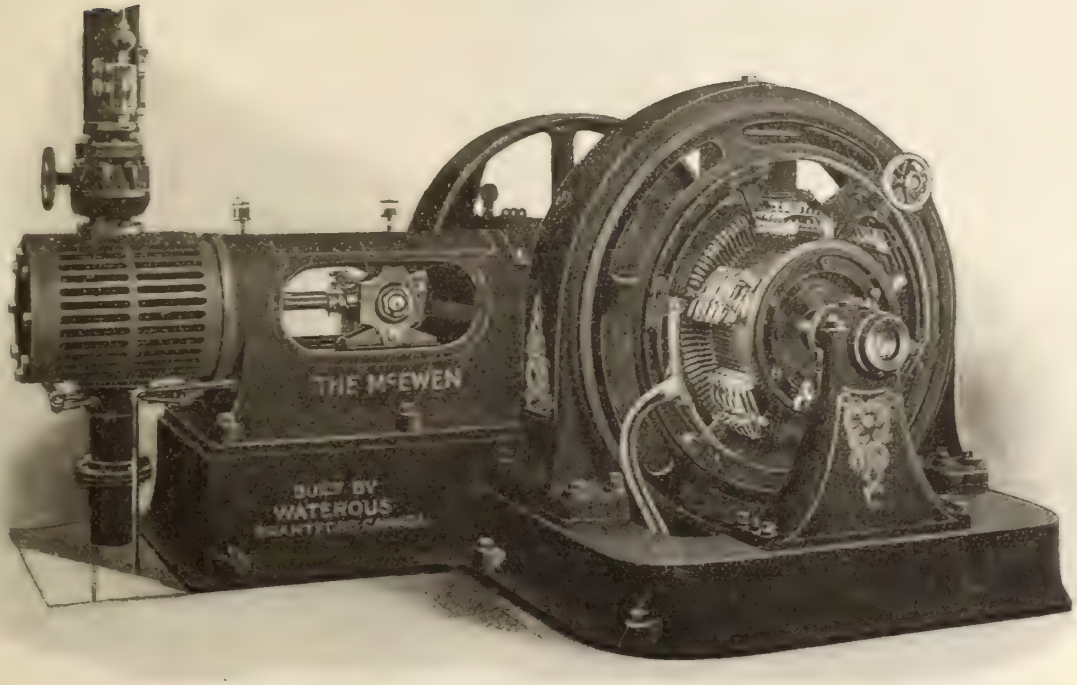

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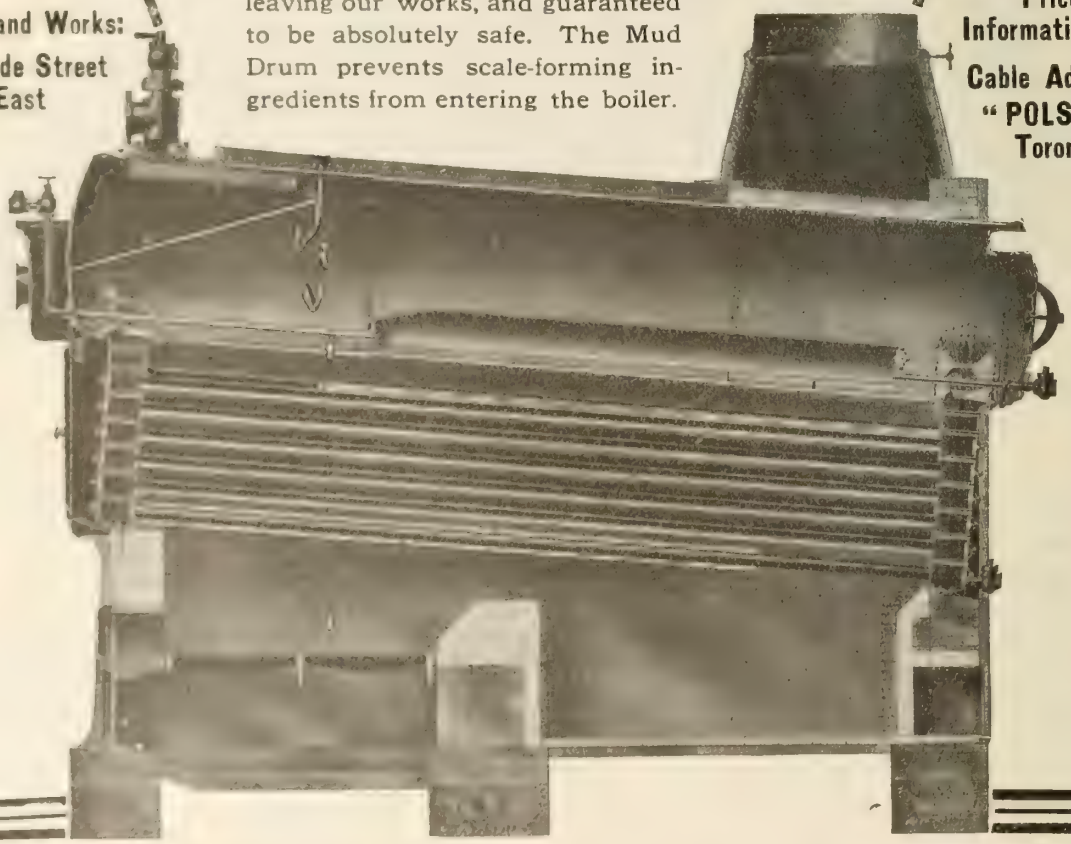

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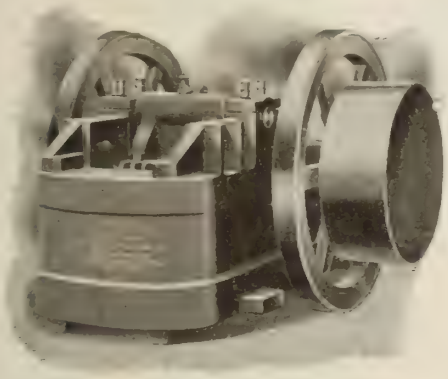

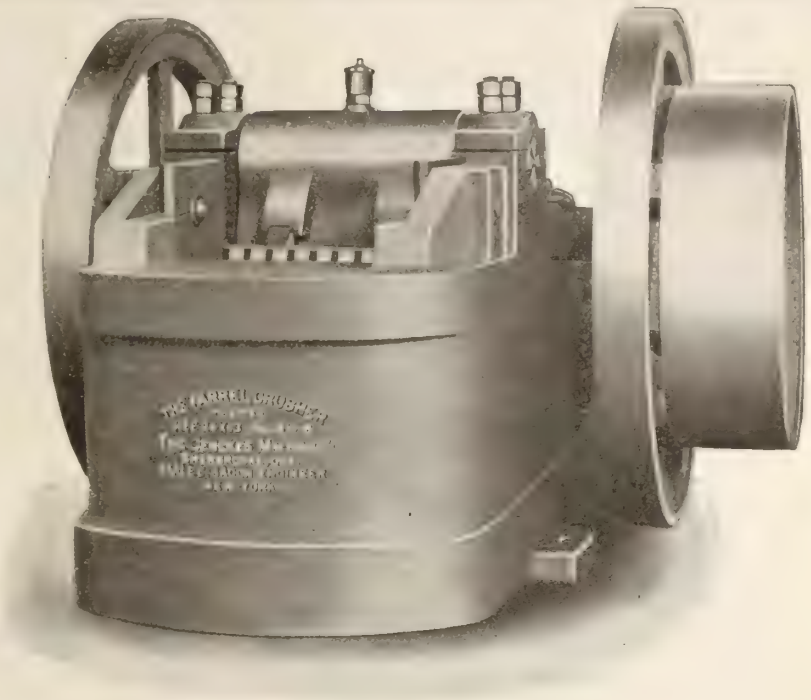

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Works { SHERBROOKE, QUE / ST. CATHARINES, ONT.

Sales Offices---Sherbrooke, Montreal, St. Catharines, Cobalt, Rossland, Vancouver.

Control

of your boiler feed is your greatest and best

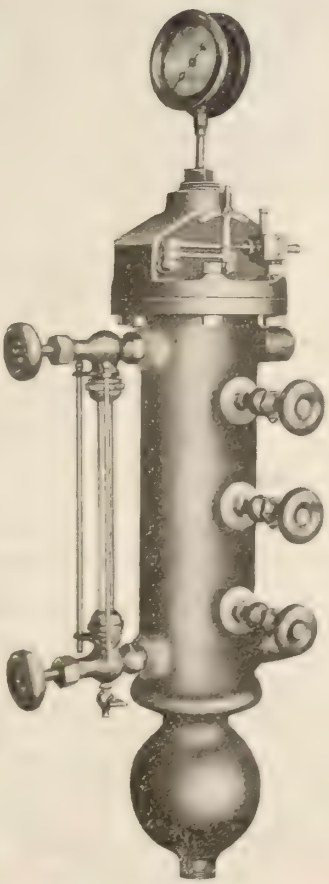
Insurance

Against Accidents.

Destruction of boiler by low water or crippled engine through high water is impossible.

Requires no attention. Is absolutely automatic.

Write for Catalog.



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Counts in

Gauge Glasses

Bishops ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES

have been tested under all conditions and have proved their superiority over all others.

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Mill Supplies MONTREAL

You, Too, Would Appreciate the Blackburn-Smith Feed Water Filter and Grease Extractor

When a thing is recommended by good people and after careful test you should be convinced. We've already presented a multitude of references. Here are more.

1. "The three Filters purchased last year have been in constant service. The elimination of grease, oils and dirt has been more nearly perfect than with any other filter we have tried."—L. A. Larson, Chief Engr., Board of Education, Duluth, Minn.

2. "Results are very satisfactory."—E. H. Kearney, Engr., John Hancock Mutual Life Ins. Co., Boston.

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8. "The Blackburn-Smith Filter installed over a year now has proven all you claim: simple to get at, quick to clean, always ready and does its work. Before we could not use our exhaust steam on account of oil."—M. McCormick, C. E., Cumberland Co. Court House, Portland, Me.

9. "We have had the Blackburn-Smith Filter in about four months and are well pleased. The insurance company inspected two boilers on the 15th inst., and everybody concerned is delighted."—G. W. Buchanan, Supt., Standard Oil Cloth Co., Buchanan, N.Y.

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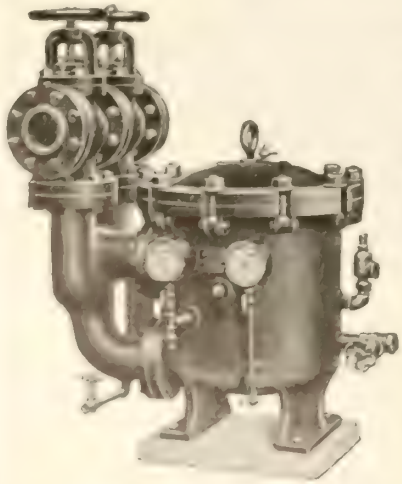

Note that in every case the Blackburn-Smith has done just what it was made for, given satisfaction and paid for itself quickly. If you want references on a case just like yours, tell us the conditions. And when you are ready to try the filter you can do so at our risk. Ask for book

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GAUGE COCK

is a necessity to every up-to-date boiler room, as it is absolutely reliable, economical and efficient in service.

It is made of the best material that can be secured, and is guaranteed leakless for years. Sent on trial.

Let us send you one on approval.

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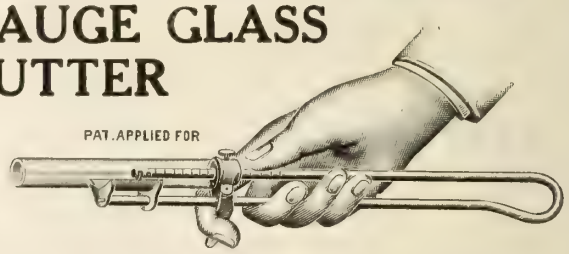
The "FLETCHER" GAUGE GLASS CUTTER



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The "FLETCHER" is constructed in such a manner as to make it the most valuable device on the market for cutting glass tubing at the required length.

It is the quickest, easiest and most accurate.

Improved Lever Attachment, with Large Rest and highest grade Diamond Cutter, assure an article of superior quality.

Our prices are the lowest. Write at once.

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Bell Mechanical Filter

(Made and Patented by BELL BROS., Ravensthorpe, England)

makes possible 99.87 per cent. purification of water

One of the chief points of advantage of The BELL FILTER is the ease and economy with which the filtering material is washed. The washing arrangement is the most important point in the construction of a filter plant if continued efficiency is to be depended upon and is the one which controls the entire results after a few weeks' working.

If the filtering material is not restored to its original condition when washed, it is only a question of time before the filters get out of order. In all mechanical filters a reverse flow of water is used in the cleansing operation, but this of itself is practically of little or no use, especially where anything of a sticky nature is arrested in the filtering bed. A current of water equal to 30,000 gallons per hour passed through a filter 8-ft. in diameter, allowing for sand in filter, is only equal to a current of three feet per minute. This speed is too slow to scour dirt from off the sides of pebbles, and a stream running at this rate would look almost stagnant. In our system of washing, while we use a reverse flow for putting the bed into suspension, we do not depend upon this for any efficient washing. The following supplies a detailed description of our system of washing the filter beds:—

As already named, our filters being erected in batteries with a common filtered water main, one or more filters are washed in one operation, the number depending upon the size of the plant; the remainder continue filtering in their usual manner; the water necessary for the washing of the section being cleansed is obtained from the machines filtering—only filtered water being used in removing the collected impurities from the filtering material; if dirty water is used bacteria and other contaminating substances are put through the strainers at bottom, consequently when the filters are washed and filtering recommenced, the whole of this contaminating matter is brought out again in the filtered water, and traces of it may gradually come away for hours. In our system the washing is done as follows, viz.:—

The wash out valves of the compartments to be washed are opened, and the inlet valves are shut. A current of clean water is forced through bottom pipe and strainers upwards through the filtering beds, putting the same into suspension. As soon as the beds are in suspension, the vertical wash valves are opened and a current of water is passed through the top pipes into the hollow shafts and hollow arms and out through back-pressure valves. When this is done the arms and shafts are revolved—breaking, stirring, and loosening the dirt, etc., from the filtering material; by means of the rakes, the beds are thoroughly broken up and the whole of the dirt loosened is carried out by the currents of water.

In our larger plants the revolving of the wash arms is done by the bevel wheels, driven from a small hydraulic, gas, oil, electric or steam motor, each shaft being put in or out of gear by a movable clutch. In the smaller plants the shafts are turned by means of hand wheels. The speed of travel of the arms is about 80-ft. per minute. The arms are so constructed in size and shape that every particle of the bed is thoroughly scoured and rubbed together. The revolving of the arms is then continued until the water runs clear, no amount of subsequent agitation bringing away any more dirt (samples of the filtering material taken from any part of the bed after washing show the whole of the contamination to be removed). The other compartments are then washed in like manner, each compartment taking from three to five minutes.

The different cleansing processes simultaneously carried on are as follows, viz:—Washing by reverse current, loosening of the dirt by the peggy leg action of the revolving arms, and the thorough breaking up of the bed by the powerful hydraulic funnel-shaped jets discharging water from the back pressure valves in arms at all parts of the bed. We guarantee the washing of our filters to be perfect, and to be better than the best hand washing. We are prepared to put down and erect our filters, where other filters have failed, and to guarantee results.

"Filtration and Softening of Water"

An excellent little book containing a large amount of valuable information about water.

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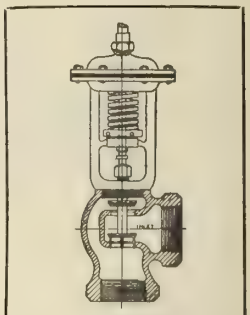
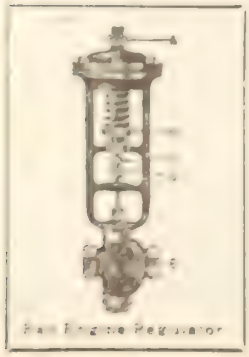

Pump Regulator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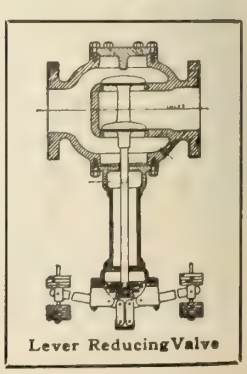
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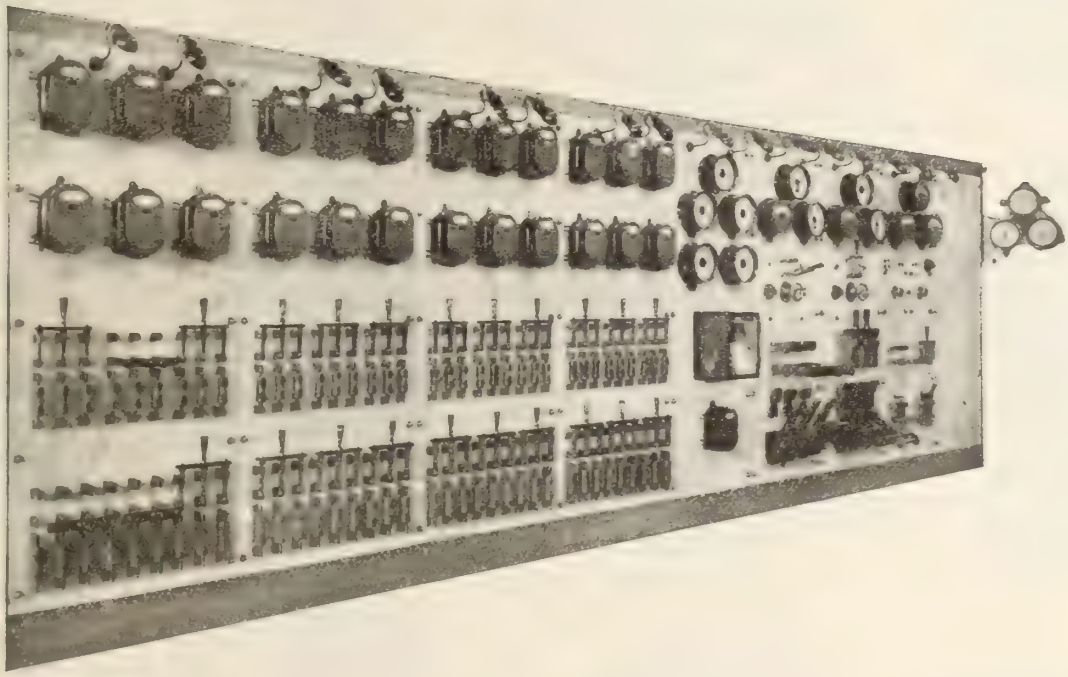

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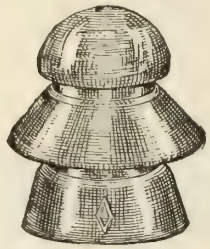
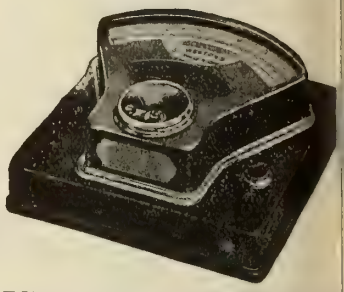


DIAMOND GLASS INSULATORS



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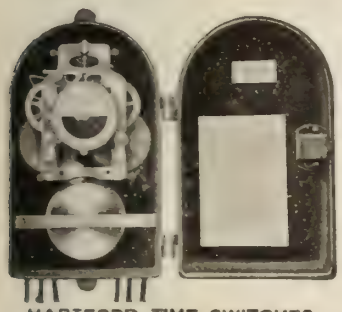

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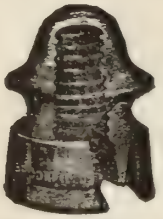

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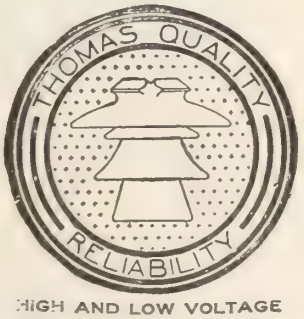

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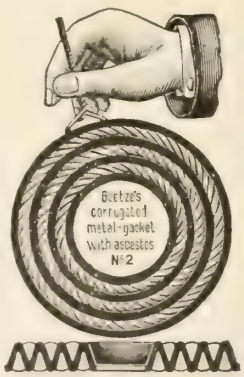
Make Up Your Mind to Make More Money

and avoid a lot of trouble by stopping **promptly, positively** and **permanently** every leak in pipe joints throughout your plant. We'll show you **how** to do it and we'll **prove** that our method will do it, **before** we take a cent of your money. We'll prove this right **in your own plant**—under your own eyes—on the **worst joints** you have—under highest pressure or temperature—in service even with **highly superheated** or **saturated steam**, and on **long lines.** We'll do this by sending you

A Supply of Goetze's No. 2 Gaskets On 90 Days' Trial Entirely at ***Our*** Risk

Then, it will be up to you to give them a try-out that will be conclusive—a trial that will show either that you don't want a Goetze's No. 2 Gasket in your plant, or that you want one of them in **every** flanged pipe joint you own. And **one** in a joint is enough—yes, even where **several** of some other kind have failed to hold. Goetze's Elastic Corrugated Copper Gaskets, with Asbestos Lining No. 2 ("Goetze's No. 2," for short) **cannot** blow out, burn out or give out in **any** way. No other one thing can save you as much trouble, time, coal, money.

If we can't prove every word of every claim, we don't want your money.



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Are you **willing** to try such a Valve Gasket at **our** risk?

Then Write Us—To-Day—For A Supply Of Goetze's Copper Valve Gaskets on 90 Days' Trial

and **try** them.

Goetze's Copper Valve Gaskets **are** for valves of Jenkins and similar types. They are made from **chemically pure copper,** with a core of the **best Asbestos.** These materials form a cushion with sufficient elasticity to insure tight closing, yet with the firmness and strength to resist the heat and pressure which so quickly disintegrate and destroy ordinary rubber or "composition" gaskets. The valve seats will close **tightly** on **this** gasket without injuring it or themselves.

You can put them in without removing valves from piping. **And then you can forget them.**

Made of **Nickel** and Asbestos if you want to use them with acids, etc.

Send for a supply of Goetze's Copper Valve Gaskets and **try** them for 90 days at **our** risk. Merely give sizes wanted, number of each, and whether with two flat sides inside, or with round hole.

Ask for Catalog of Packings for All Power Plant Purposes.

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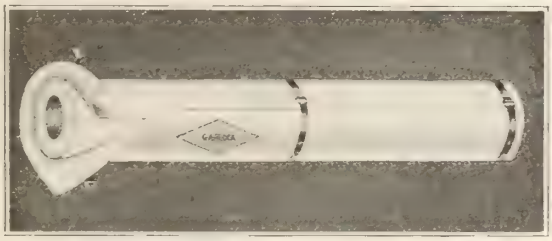
THE RESULTS ARE increased earning capacity and more profit for the Plant.



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Cut out the Sunday work, not only in the fall but all the year round. You can if you pack your engine with

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Don't let slipping belts waste power—drain away profits. Plug up the leaks—save time, money, *power*, by investigating installing Goodyear Rubber Belting.

Goodyear Rubber Belting stands for ***saved energy—economy.*** Built up of plies of rubberized fabric, cured and vulcanized into the solid piece. Neither slips nor stretches. Has the cohesiveness of rubber with the enduring strength of a specially woven cotton duck fabric from which all stretch has been taken out. It is steam, water, weather and rot proof.

The same high grade materials, the same skillful workmanship and the same years of experience that have built such famous service into the products of the Goodyear Tire & Rubber Co., U. S. A., are doing the same for Goodyear Rubber Belting and our many other rubber products.

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High Efficiency Belting

Every size for every purpose—1 inch to 60 inches wide—2 plies to 8 plies thick.

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The highest grade made. Heaviest duck, best rubber, seamless, tough, durable. The saving main-drive belt for **Paper, Pulp** and **Lumber Mills**—for *all* mills where the horse power transmitted is large and the demand for tensile strength is great.

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Goodyear Rubber Belts quickly earn their cost in pains and power saved—yet they cost less than the common kind. Let our expert solve your problem. Send requirements or write for catalog to-night.

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General Offices—Toronto Factory - Bowmanville, Ont.

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RENOLD PATENT SILENT CHAINS

(SEE PAGES 275-6-7 IN THIS PAPER OF OUR INSTALLATIONS)

What Users Think

Montreal, Feb. 8, 1909

Messrs. Jones & Glassco, Montreal

RE RENOLD SILENT CHAIN DRIVE.

GENTLEMEN,—In reply to your inquiry of Jan. 30th, I may say that the Renold Silent Chain Drives we have installed are giving every satisfaction.

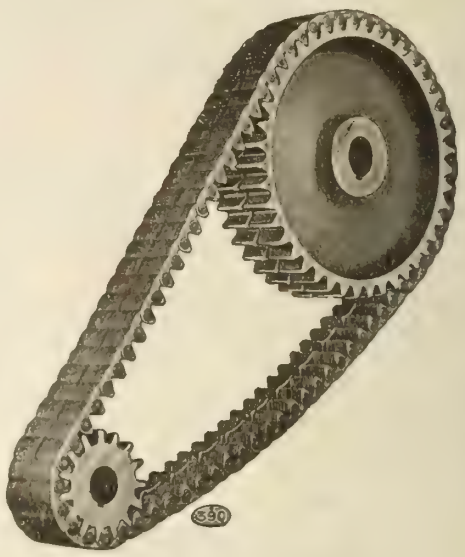
Our first drive was installed to replace a 12 in. belt which was giving us trouble on account of short centres; this chain has run continuously for four years without the slightest trouble.

Our second drive was installed on a mixing machine doing heavy duty and which had previously broken up two sets of spur gearing; this chain has run over three years with no sign of wear yet.

Our third drive was installed on a callendering machine after breaking two sets of helical gears, and this has been so successful that we are now installing two more similar drives.

I would be perfectly willing to make an appointment with any person genuinely interested and show him the drive in operation.

The above comes from one of the largest manufacturers in Montreal and is signed by the Mechanical Superintendent. Up to the present (1911) these drives have not received repairs of any kind.

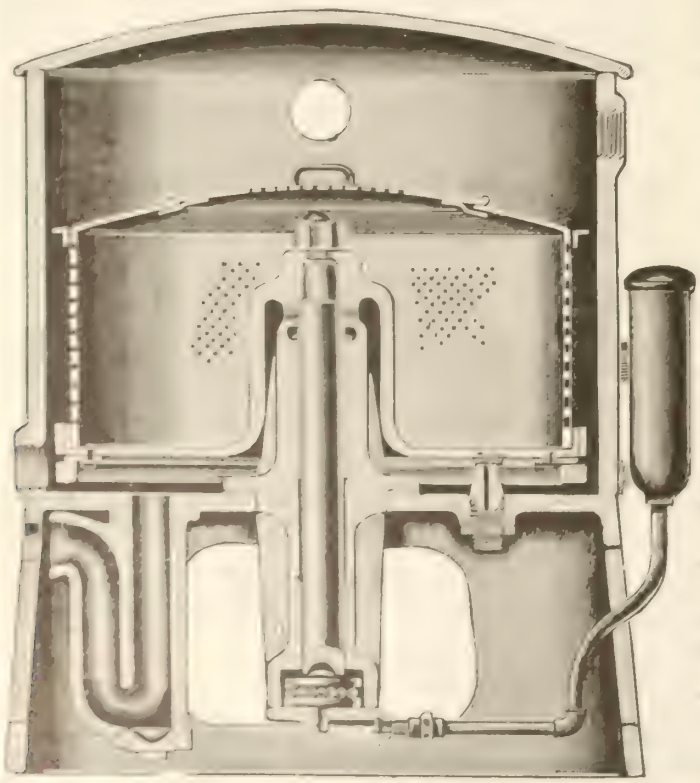


Write for Catalogue

So satisfactory has their experience been that they are ordering (for a new extension) Renold Chain Drives throughout, transmitting about 400 H.P.

Jones & Glassco Sole Canadian Agents **Montreal**

IMPROVED WASTE MACHINE
WITH
WASHING ATTACHMENT

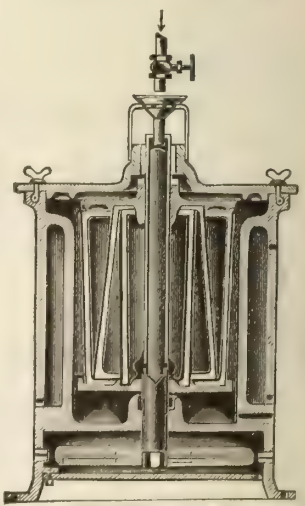


ECONOMIZE
Save Oil—Save Waste

We Manufacture
OIL and WASTE MACHINES, CHIP MACHINES, TURBINE CENTRIFUGAL OIL FILTERS, and CENTRIFUGAL EMULSION MACHINES

We have machines with—The E. B. Eddy Co., Ltd.; Grand Trunk Railway; Can. Pac. Ry.; Dominion Coal Co.; J. R. Booth; Toronto Water Works; T. Eaton Co.; Montreal Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oat Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co.; Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.; Consolidated Mining & Smelting Co.; Montreal Cotton Co.; Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd.; J. & P. Coates, Ltd., and many others.

TURBINE CENTRIFUGAL OIL FILTER



ASK FOR CATALOGUE

The General Supply Co. of Canada, Limited
General Agents
Ottawa Toronto Winnipeg

The Canadian Oil and Waste Saving Machine Co., Limited
BROCKVILLE, ONTARIO

Won't Crack, Break or Lose its Insulating Value from Vibration or Rough Usage

The temperature of high pressure pipes soon dries out molded and ordinary pipe coverings. Then expansion and contraction of the pipes and vibration reduce the carbonate of lime (chalk) and other like materials with which these coverings are filled to a powder. This powder settles at the bottom of the canvas covering, leaving the top insufficiently covered, and gradually sifts through the canvas. Thus what little insulating properties they originally had are quickly lost.

J-M Asbesto-Sponge Felted Pipe Covering

retains its high insulating properties indefinitely. Pipes covered with it can even be walked upon without injury. This is because it is made of many layers of fine paper, composed of pure, long-fibred Asbestos and a small quantity of granulated sponge. It has been found in perfect condition after more than fifteen years' service on underground pipes. Can be taken off pipes and replaced without injury. This is an important feature around manufacturing plants where changes are constantly occurring.

Ask Nearest Branch for Sample and Booklet

THE CANADIAN
H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos and Magnesia Products — ASBESTOS — Asbestos Roofings, Packings, Electrical Supplies, etc.

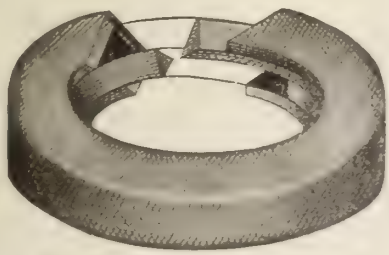
TORONTO, ONT. MONTREAL, QUE. WINNIPEG, MAN. VANCOUVER, B. C.

924

The ASBESTOS & RUBBER GOODS CO.

141 King Street East, TORONTO, Ont.

43 St. Francois Xavier Street, MONTREAL, Que.



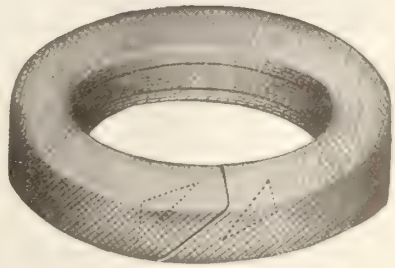
Belmont "1903" Expansion Ammonia Packing

"Attention, Mr. Engineer"

If Ammonia Packing is giving you trouble, give Belmont Split Ring a trial, POSITIVELY GUARANTEED.

Attention is called to the unique THREE-BREAK-JOINT feature of this ring, and it is the only packing so constructed.

A full stock of all other ENGINE SUPPLIES on hand.

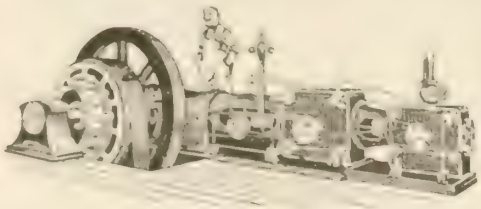


Belmont "1903" Expansion Ammonia Packing

Don't fail to mention this paper in writing to advertisers.

HEAR! HEAR! What do you think of it now?

This is the way we guarantee your engines and pumps to work for ONE YEAR when packed with



Rhodes Metallic Packing

ONCE USED—NEVER CHANGED

AGENTS WANTED

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

c o C. W. SPENCER & CO., 55 St. Francois Xavier Street, Montreal, Quebec.

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

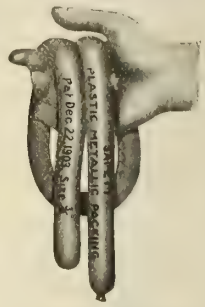
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

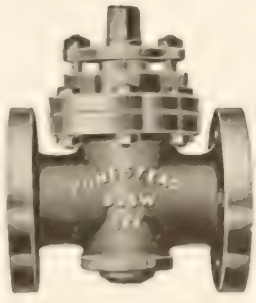
Practically Frictionless



Sold on APPROVAL

HOMESTEAD
STRAIGHTWAY VALVES

ALWAYS OUTLAST
OTHER VALVES



For Pressure Up to
5000 lbs. Per Sq. In

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details.

Write

Homestead Valve Mfg. Co.

PITTSBURG, PA.

Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited

Valve Manufacturers

WALKERVILLE - ONTARIO

Did you get this point from last month's ad.—that

Federalite Pump Valves

Cost LESS and Wear LONGER Than the Best Rubber Valves

Just read this guarantee:—

Plunger and condenser packing is sold under the guarantee to outwear any other packing working under the same conditions, on hot or cold water, oil, lye, potash, creosote, ammonia, gasoline, brine, or weak acids. You send us the sizes, we send the goods on trial, not to be paid for until you are satisfied that this packing will save you money.

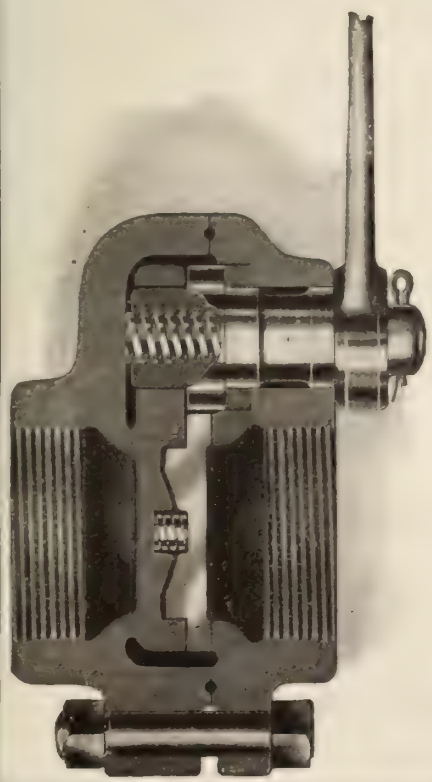
IF ONE EVER BREAKS WE REPLACE IT FREE.

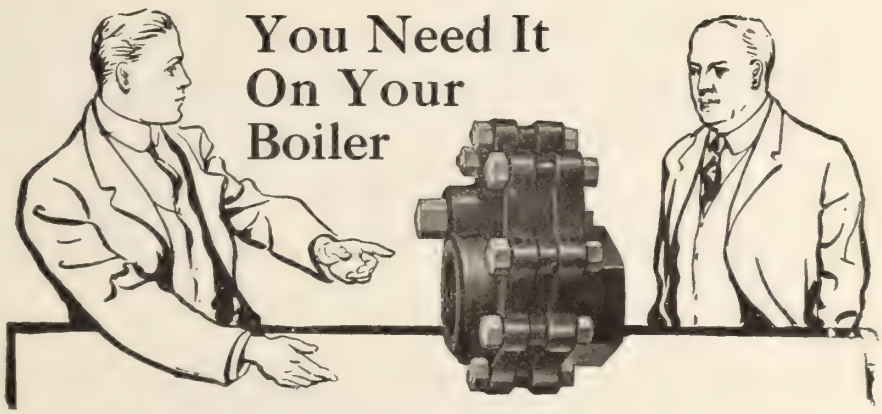
Write to-day. Now.

H. L. PEILER & COMPANY

380 St. James Street, MONTREAL 69 Adelaide Street East, TORONTO Macleod Building, MONCTON, N.B.
Western Agents: W. E. SKINNER, Limited, 618 Somerset Building, WINNIPEG

"Everlasting" Blow-off Valve





Every boiler has a blow-off valve that may be a certain loss to you. ***Wasted steam*** means ***wasted fuel.*** Read this unsolicited testimonial from a satisfied user of "Everlasting" Blow-off Valves:

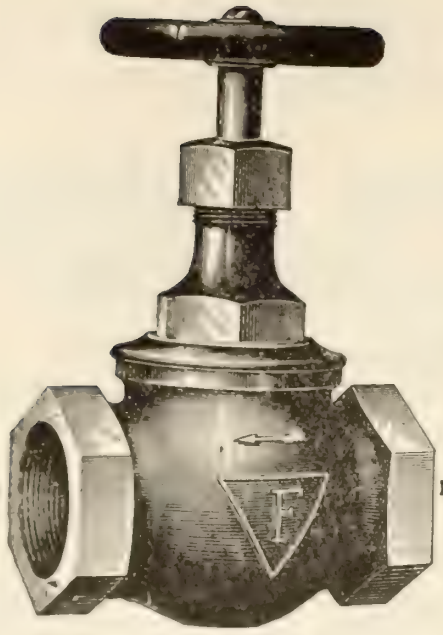
Haileybury, Ont., Oct. 3rd, 1911

Gentlemen,—Enclosed please find my cheque for $15.00 in payment of your invoice on date of August 3rd, being for one bl w-off valve.
This valve is giving great satisfaction, and the cost is nothing compared with the services we are receiving from same. Kindly acknowledge rece pt and oblige.

Yours truly, CLEMENT A. FOSTER.
J. Arthur Griffith, Manager.

Engineering Specialties Company

1080 King Street West, Toronto, Canada



FAIRBANKS VALVES

"The World's Standard"

Will appeal to the discerning buyer. They are widely known and popular among all engineers—and deservedly so. In design they are simple—in construction and composition only the finest workmanship and best-grade bronze have been used. They are heavily built and well proportioned, being fully capable of standing rough treatment and any pressure up to that specified for each valve.

WE SHALL APPRECIATE YOUR
FURTHER ENQUIRIES

THE CANADIAN FAIRBANKS-MORSE CO.
LIMITED

Fairbanks Standard Scales—Fairbanks-Morse Gas and Gasoline Engines—Safes and Vaults

Montreal, Toronto, Winnipeg, Vancouver, Calgary, St. John,
Ottawa, Saskatoon.

TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

Don't fail to mention ***this paper in writing to advertisers.***

YOU CAN'T GO WRONG

WHEN YOU SPECIFY

Lunkenheimer Oil and Grease Cups

THEY ARE MADE OF THE HIGHEST GRADE OF MATERIALS AND ARE VERY STRONG, PARTICULARLY IN THE SHANK, THE PART SUBJECTED TO THE GREATEST STRAIN.

JARRING OF THE MACHINERY TO WHICH THEY ARE ATTACHED WILL NOT SHAKE THEM TO PIECES, NOR WILL IT AFFECT THE SETTING OF THE FEED.

ALL CUPS ARE EASILY FILLED AND THE SIGHT-FEEDS ON THE OIL CUPS ARE LARGE, PERMITTING THE OIL TO BE SEEN FROM QUITE A DISTANCE, AND DO NOT EASILY BECOME OIL SPLASHED.

LUNKENHEIMER LINE OF OIL AND GREASE CUPS IS A VERY LARGE AND COMPLETE ONE, AND AMONG THEM CAN READILY BE FOUND A CUP PARTICULARLY ADAPTED TO SUIT ANY REQUIREMENT.

"Most supply houses sell them – yours can—if they dont or wont—tell us."

The Lunkenheimer Company

Largest Manufacturers of High Grade Engineering Specialties in the World

General Offices and Works: CINCINNATI, OHIO, U.S.A.

CHICAGO	NEW YORK	BOSTON	LONDON, S.E.
185 North Dearborn Street	64-68 Fulton Street	138 High Strreet	35 Great Dover Street

NELSON TRADE-MARK REGISTERED Bronze Gate Valves

Send your order direct to us if your dealer hasn't complete stock

We will take care of you

Nut screwed on, *not cast*, so can easily remove wheel to renew packing.

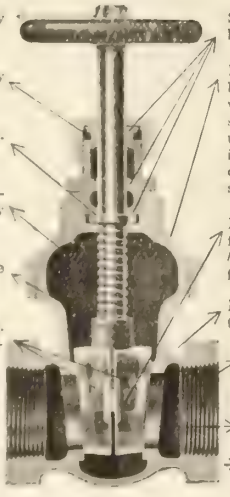
Gland on Medium and Extra Heavy valves.

Stem collar cast solidly on the stem. Collar is *always* there.

Threads. Scientifically and mechanically correct, strong, wear well, easy to operate.

Wedge. The only spreading device in the valve. *One piece.* Simple.

Discs. Two. Simple. Compact. Can't get out of order. Automatically rock into perfect alignment with the seats, not only when the seats are new, but should the seats become distorted from their original angle, through sagging of the pipe or otherwise, the discs will still *make up tight* with the seats.



Stem has bearing at *three* points, keeping the stem central and steady.

Bonnet. Screwed on outside of body on Medium and Extra Heavy valves, strengthening it for severe service. The outside bonnet is not used on Standard valves, as the body is made so strongly that it is not required for 125 pounds working pressure.

Disc Guides. These guide the discs freely, making operation easy, *no binding at any point*, prevent discs from scraping on the seats.

Body. *Strong*, because well proportioned, well balanced, curved shape.

Threads. Cut *taper*, to standard gauges, for good, tight, pipe connection.

100% opening, *no obstructions.*

Hexagons unusually long and very heavy.

NELSON

Valves are also made in the Globe and Check types, in all sizes, for any pressure, for any purpose.

Extra Heavy, for 300 pounds. Medium, for 175 pounds. Standard, for 125 pounds.

Nelson Valve Company, Philadelphia

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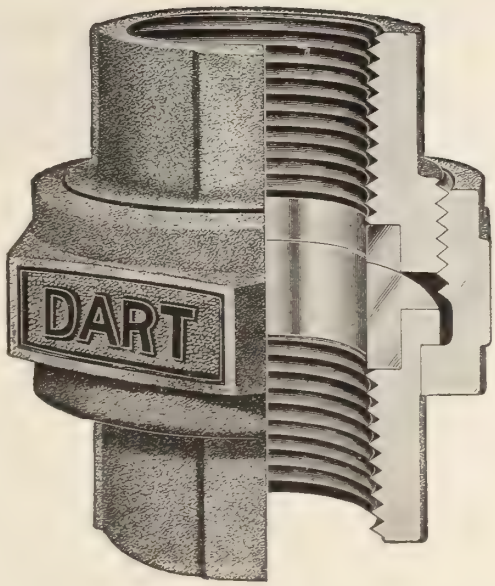
	MINNEAPOLIS [illegible] Andrus Bldg		BUTTE 56 E. Broadway	

Inside view of Standard Valve

Wishing will not make a perfect joint

But a "Dart" Union Will

The bronze to bronze joint of the Dart Union eliminates all possible chance of rust or corrosion, so that the joint will stay tight until deliberately loosened.



As the faces of the joint will not rust or corrode, the union may be connected time after time without impairing its efficiency.

Dart Unions have no maintenance cost; do not have to be replaced, and positively eliminate all loss due to leaks. These are not merely claims, but guaranteed facts.

Nearly all dealers sell them and they are made in all convenient types—flanged, elbow, tees, etc., male or female.

DART UNION CO., Limited

93-97 Niagara Street, TORONTO, ONT.

Don't fail to mention this paper in writing to advertisers.

The 20th Century Shaking and Dumping Grate Bar

SHOWS RESULTS.

Saves fuel and cuts labour of stoking in half

Gives more steam and increases output of plant.

For heating boilers, power boilers, brick-kilns, gas producers, etc.

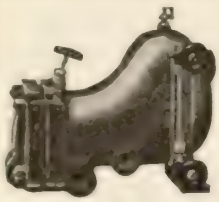
Maximum air-space, greater Dumping Capacity than any other Bar.

We supply our Grates to burn any fuel and guarantee long life and satisfactory working.

Prompt attention and expert advice cheerfully given

The Boiler Repair & Grate Bar Co.

Head Office:—69 Adelaide St. East, Toronto Phone—Main 1608



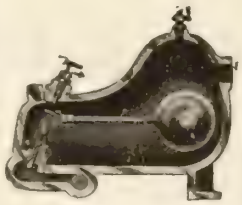
McDANIEL IMPROVED STEEL TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
28 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, ONT.

WAINWRIGHT WATER HEATERS

A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS are designed specially to fulfill the requirements of Bleacheries, Dyehouses, Paper Mills, Laundries

ALBERGER CONDENSOR CO.

140 Cedar Street, NEW YORK CITY

Agents: CANADIAN FAIRBANKS CO., Limited
Montreal, Toronto, Winnipeg, Vancouver

THE

CANADIAN CASUALTY

AND

BOILER INSURANCE COMPANY'S

NEW BLANKET POLICY IS THE MOST LIBERAL INSURANCE CONTRACT NOW ON THE MARKET

IT COVERS ALL LOSSES TO LIFE AND PROPERTY

INCLUDES HIGH CLASS INSPECTIONS AND ENGINEERING ADVICE

CONTINENTAL LIFE BUILDING
TORONTO

A. M. Wickens, Chief Engineer.

C. Norie Miller, Manager.

Phone Main 6941.

THE "IDEAL" PACKLESS VALVE

Should Interest You, Mr. Engineer.

It is a valve that needs no attention, after once installed, in the way of packings.

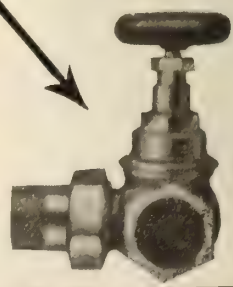
Does away with expenses in keeping up an ordinary valve and prevents accidents that are liable to occur by escaping steam, water, or gas.

The "Ideal" Packless Valve is neat in design and construction and is made to meet the requirements of every boiler room.

It is guaranteed not to leak under any pressure up to 200 pounds.

We invite comparison between any of our products and those of other manufacturers whether in material or workmanship.

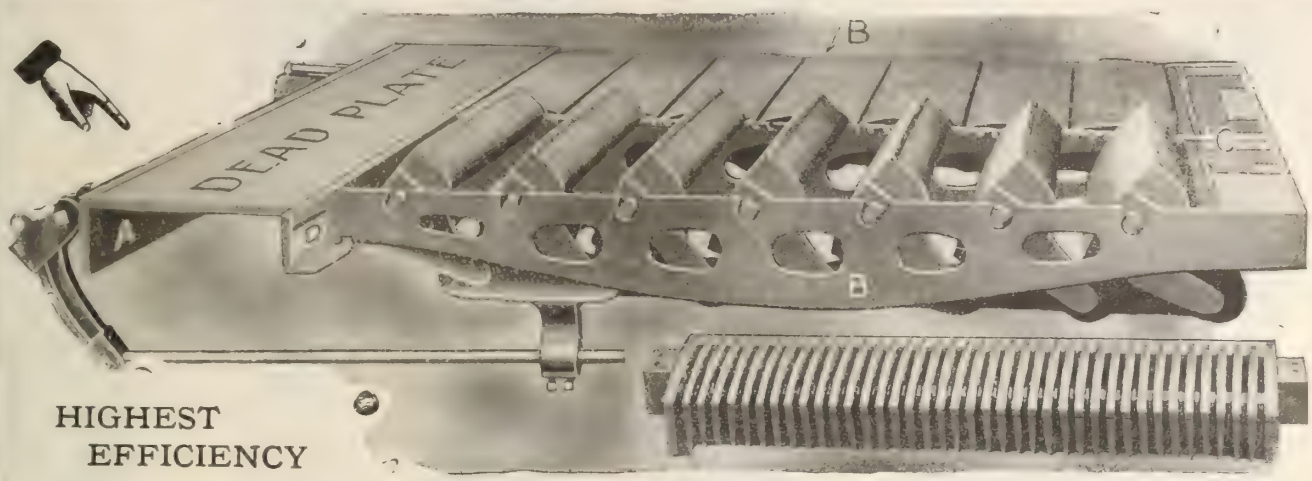
You will save much trouble by writing us.



The Ideal Packless Valve Co., Ltd.
WALKERVILLE, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

The Cyclone Shaking and Dumping Grate Bar



HIGHEST EFFICIENCY

You can generate more steam at less cost if you install a "CYCLONE" Grate It is the only grate from which you can get the maximum results from burning the cheapest kind of fuel. It is impossible to waste fuel when grates are shaken, as the openings between the bars are no greater "when shaken" than when left level. Constructed so as to allow 68% air space, and 90% underdraught, and is guaranteed never to get out of order or warp.

WRITE US AT ONCE FOR CATALOGUE.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

186 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS

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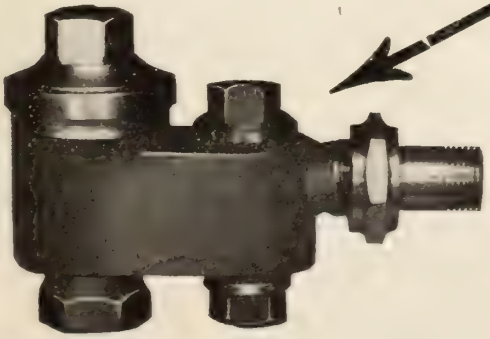
THE "ECONOMIC" VACUUM VALVE

Insures Maximum Heating Effect from Radiation by PERFECT CIRCULATION.

It has two chambers, the first one being a dirt chamber in which the condensation is screened before entering the second chamber. The second chamber containing the Float is a perfect valve, retaining absolutely the steam and eliminating the air and water of condensation automatically by means of the float.



The Valve is well seated as well as water sealed and causes the engineer no trouble whatever.

The condensation chambers are simple and can be easily cleaned

This vacuum valve is strictly up-to-date in every respect, and by a single operation you can attach it to the old gravity type of heating apparatus, keeping the radiators always hot, with an economy in fuel consumption.

Eliminates all back pressure on engines supplying the exhaust.

YOU CANNOT AFFORD TO OVERLOOK THIS.

Write us at once for catalogue and full particulars.

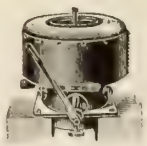
Canadian Steam Boiler Equipment Co. *Limited*

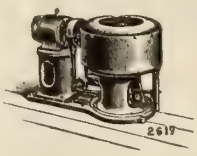
186 Queen Street East, Toronto.

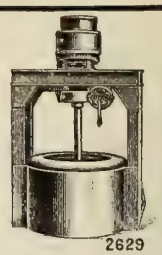
BELT DRIVE

BELT DRIVE

ENGINE DRIVE


WATER DRIVE

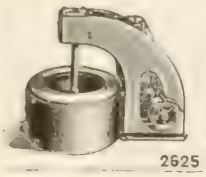

ELECTRIC DRIVE

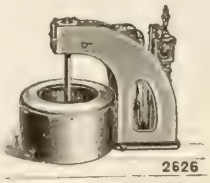

2629
ELECTRIC DRIVE

HYDRO-EXTRACTORS

To Meet All Requirements

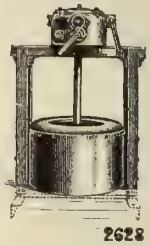
BELT DRIVE


2625
BELT DRIVE


2626
ENGINE DRIVE

2627
ELECTRIC DRIVE

2630
ELECTRIC DRIVE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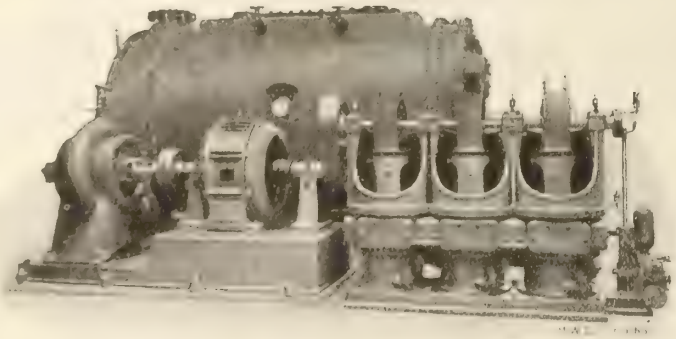

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Made in Many Sizes

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Automatic Sprinkler System Pumps.
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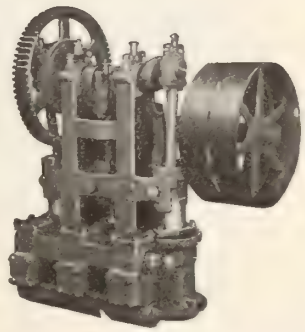

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Steam and Power Pumping Machinery

Here are a few reasons why you can purchase Marsh and American Pumps with the confidence that comes only with the feeling that you are getting the very best.

GUARANTEE: Every Marsh and American Pump is fully guaranteed to satisfactorily meet the service for which it is recommended.

BRONZE FITTINGS: Complete bronze fittings are part of the equipment of every pump.

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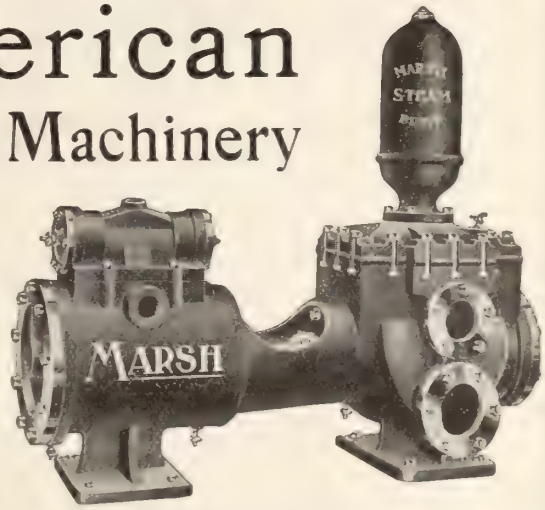

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to meet all requirements. AND BEST OF ALL IS

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THE BABBITT METAL WITHOUT A FAULT

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Magnolia has made its friends and reputation by such instances as are cited in the following letters, and it is just such trying conditions that bring out the true worth of Magnolia in strong contrast with all other bearing metals of whatever kind:—

Dear Sirs:— West Irvine, Ky., Dec. 8, 1910.

I have used lots of MAGNOLIA METAL, in fact **I will not use any other.** I am running a 200 H.P. Automatic Engine **heavy** loaded. I took charge of it four years ago when I found it in bad shape. It was reported to me that I could not hold Babbitt Metal in the Quarter Box or crank brasses which I found to be true. I made an order for some "Magnolia" Metal and used it in both places and have never had any trouble since, in fact they hardly run warm. I believe it to be the **only** metal and will advise all Engine men who have trouble with hot boxes to try it and they will get out of trouble sure. Yours respectfully,

Charles Barkleroad, Engineer,
MOWBRAY & ROBINSON LUMBER CO.

Gentlemen:— San Francisco, Cal., Jan. 27th, 1911.

Am an Engineer and have had dealings with your bearing metal and have found it an A No. 1 all around bearing metal.

Have used it in gas and steam engines which I have built, and am now building a direct connected dynamo engine to run at 500 R. P. M. The gas engine runs at 1800 R. P. M., and I have inquired from the people who are now using it and received word that the metal (Magnolia) is in first class condition after a very severe test; engine running day in and day out without any excessive use of oil, and bearing set up snug, load being very uneven.

MAGNOLIA is the **only** metal in my belief that would stand such use.

I remain Yours truly,
WILLIAM SCHINDLER, No. 105 Andover Ave.

Gentlemen:— Roanoke, Va., Dec. 17, 1910.

For the advantage of all engineers, it affords me the greatest pleasure, with over 15 years' of Sea and Shore experience, to recommend MAGNOLIA METAL as being the most perfect bearing. It surpasses all other metals used for that purpose. Among its many advantages are its long wear and its very high test of anti-friction; it can be easily worked; it requires less oil and will wear longer than any other metal I have ever used.

While stationed on the U.S. Solace from 1893 to 1900, on our voyage from Ney York to Manilla while going through the Suez Canal in the Bitter Lake, we had an occasion to refill our high-pressure crank-pin brasses with Magnolia Metal. The bearing was well fitted to the crank-pin and adjusted. Upon reaching Manilla this vessel was ordered to the Pacific Asiatic Station as a Naval Transport and Supply Ship, and was run very hard, making constant trips between Manilla, China and Japanese ports, and San Francisco, U.S. When I left the vessel, we had made a run of over 50,000 miles. This bearing after being readjusted, I left in perfect condition.

Very respectfully,
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for HIGHEST ECONOMY and RELIABILITY

Sole Licensees for Great Britain and the Colonies

Douglas & Grant

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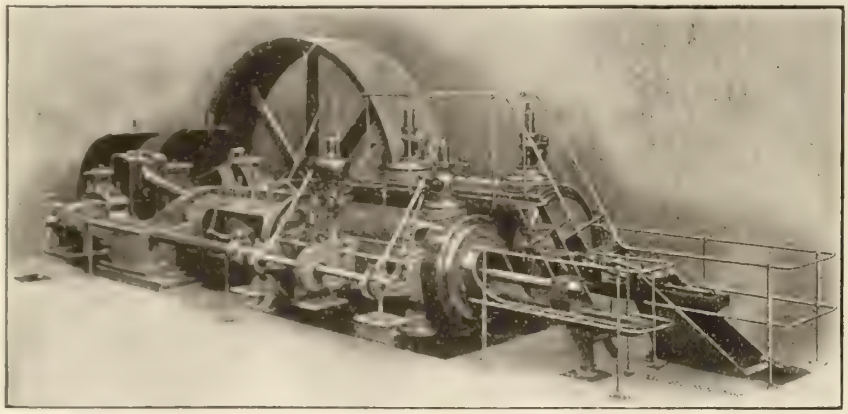

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Aero Condensers. All water recovered, none required for condensing, and heated air obtained for manufacturing purposes.

SURFACE and JET CONDENSERS, Etc.

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The Peer of Pipe Cutting and Threading Machines

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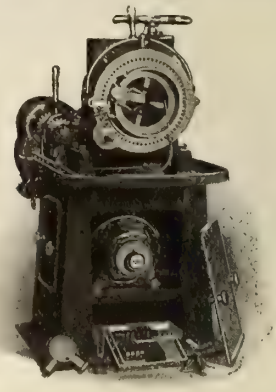

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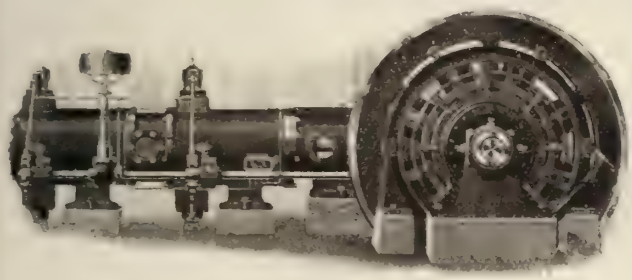

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Tandem Cylinder with Crosshead for Generator Drive. Heavy Duty.

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Geo. H. Hees, Son & Co., Toronto.
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And hundreds of others.

It is applicable to all types of boilers.

Write us to-day for our proposition and literature.

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NO LOSSES

THERE are no grate bars in a Jones stoker, consequently NO LOSS of fuel through the bars.

The gases are driven off the coals and mixed with air ***beneath*** the fuel bed, pass through the fire, are brought up to the ignition temperature and consumed, consequently NO LOSS in unburned gases! NO SMOKE!

Utilizing the fuel with a minimum of loss, and with the automatic regulation of the steam pressure by the steam pressure itself, make a Jones Underfeed Stoker installation an ideal system of firing a steam boiler plant.

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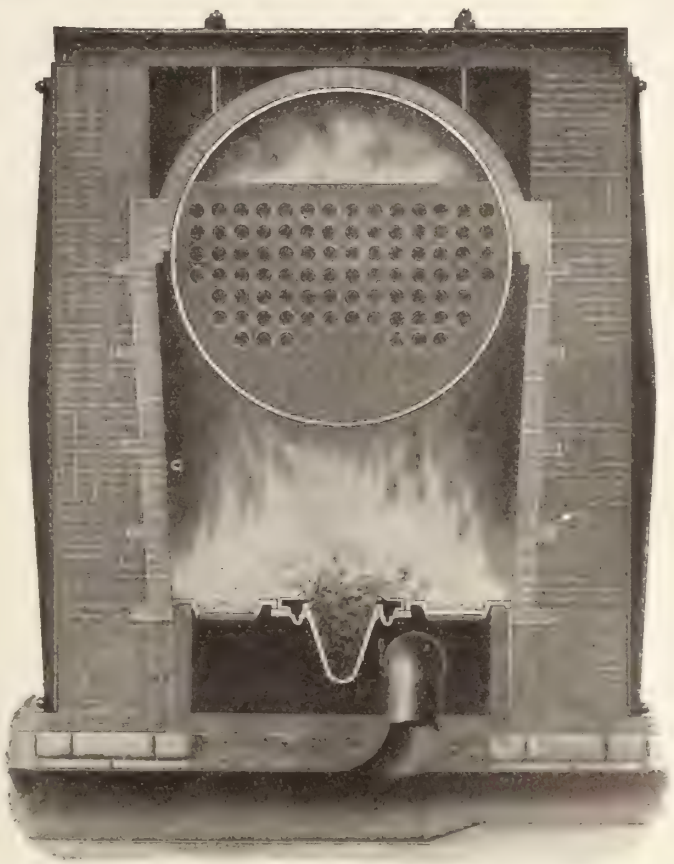

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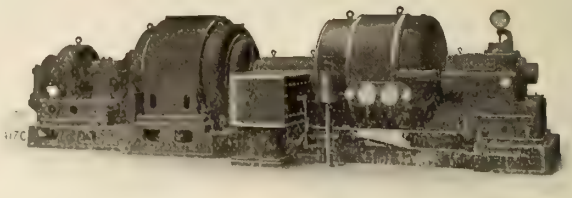

Embody many distinct improvements over any other type made.

SOME OF OUR INSTALLATIONS IN OPERATION :

Aston Manor Electricity Works	2500 K.W.	Birmingham Corporation Elec. Wks.	1000 K.W. (8)
Repeat Order	2500 K.W.	British Admiralty (Chatham Dockyard)	350 K.W. (Exhaust)
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Every unit an unqualified success.

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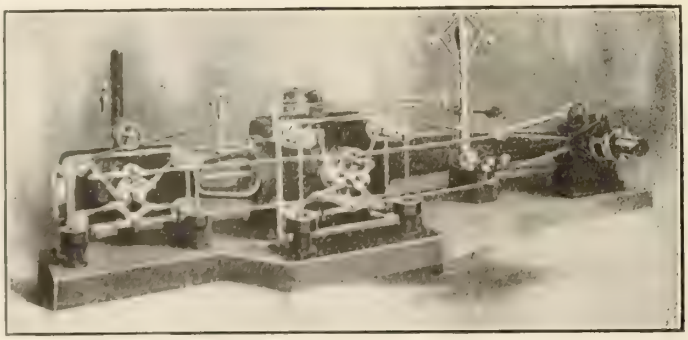
BOARD OF TRADE BUILDING, - - MONTREAL.

Tandem Compound Leonard Corliss Engine

Particularly adapted for Electrical Traction and Rolling Mill Service.



Economical, Durable, equal to the best and superior to most other Corliss Engines on the market.

One of our customers writes as follows:—

"We have much pleasure in stating that the Leonard Corliss Engine you installed for us over eight years ago is giving splendid satisfaction, and is, to-day, operating at a minimum of expense to us. Both it and our Leonard Automatic Engine have been a source of much comfort to us in the performance of the work they have to do."

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Manufacturers of High and Slow Speed Engines of all kinds, Boilers, Heaters, Tanks and Complete Steam Plants

Canadian Agents for "Browett-Lindley" English Vertical High Speed Engines, "National" Gas Engines and Gas Producers.

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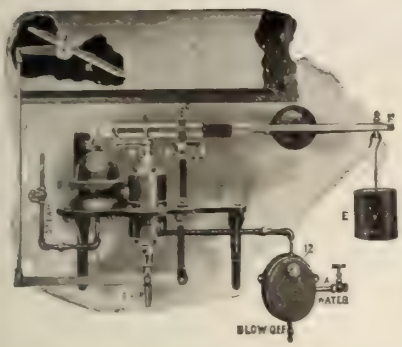

WITH A

Stillman-Carmichael Damper Regulator.

The SAVING effected in FUEL by the installation of this Regulator will vary from 5 to 18% and the first cost is very small.

It will REGULATE High and Low pressure STEAM BOILERS, Blowers and Pumping Engines.

One Regulator will govern one or more Boilers. It will close or open wide the damper or dampers on a variation of ONE POUND of STEAM.

We furnish these Regulators subject to 30 days' trial.

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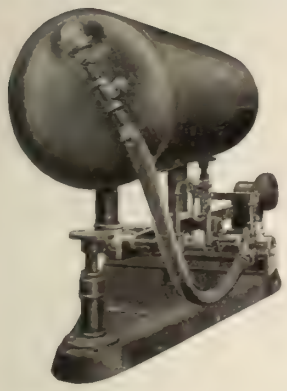

The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

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Morehead Mfg. Co.

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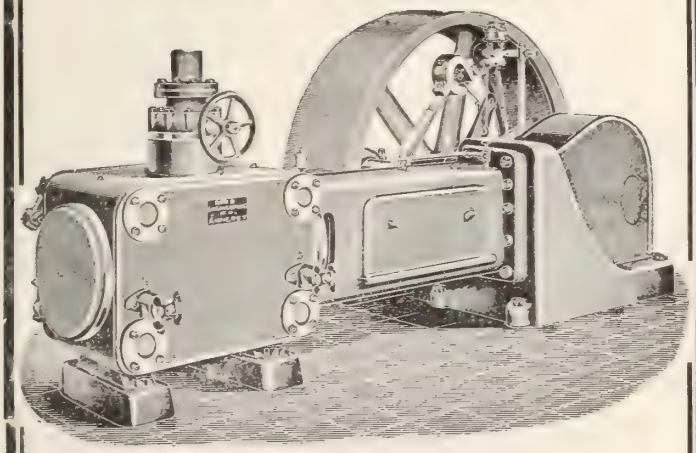
Canadian Representatives—Geo. W. Cole, c/o A. R. Williams Machinery Co., Toronto, Ont.; W. H. Markle, Montreal; Park Bros., Chatham, Ont.; W. H. Rosevear & Son, Winnipeg, Man.

Without Springs, Dashpots or Disengaging Parts, the

Robb-Armstrong CORLISS ENGINE



gives Corliss efficiency at any speed up to 200 revolutions per minute.

The simple, positive valve gear makes unnecessary the attention which must be given releasing gear engines.

Absolute safety is secured because the engine can't "run away"—there is no governor belt to break, no spring releasing gear which may fail to trip.

Important parts of the valve gear are enclosed and run in a bath of oil.

The cut-off is controlled directly by the governor, not through the indirect action of releasing gears.

Robb Engineering Company, Limited

WORKS:

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39-7

GOLDIE CORLISS STEAM ENGINES

Are Being Installed in Canada's Largest and Most Modern Power Plants.

SOME OF THE REASONS WHY ARE:

The excellence of Material and Workmanship and their good general design.

The Frame is Heavy and Very Rigid.

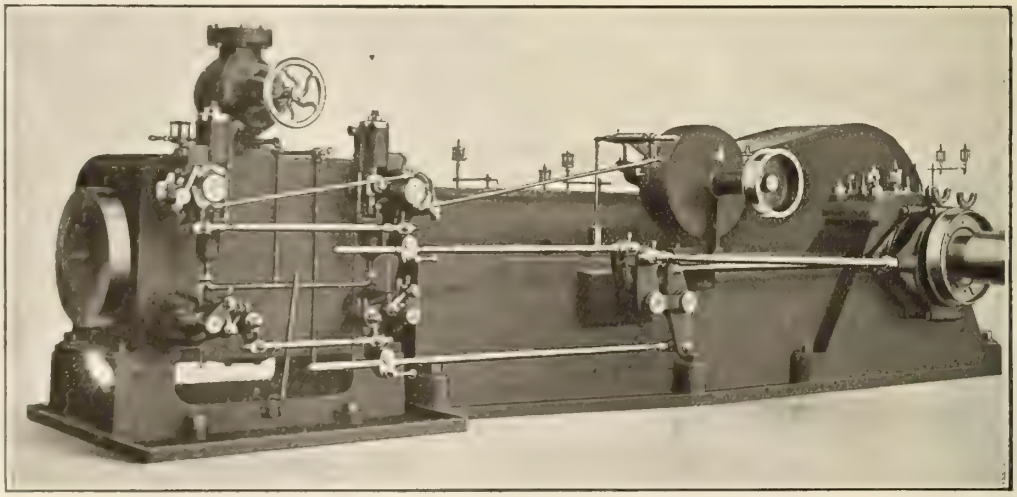
They have Four-piece Main Bearing with wedge adjustment on both sides.

The Outer Bearing is Ring Oiling.

The Crank, Crosshead and Valve Motion Pins are Case Hardened and Ground.

Connecting Rod is one Solid Forging.

Very close Regulation



VALVES are double ported, ground to size, seats lapped and edges of valves and ports are planed with special planer.

HEAVY DUTY GOLDIE CORLISS STEAM ENGINE

The above are a few of the special features which have made the GOLDIE CORLISS so popular among Canada's Power Users.

Our Engineers will be glad to go into details as to possible saving by installing your own plant.

ASK FOR CATALOGUE, ETC.

The Goldie & McCulloch Co., Limited

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Municipal Power Plant, the City of Lethbridge, Alberta

By Arthur Reid

The Accompanying Descriptive Article on the Municipal Power Plant at Lethbridge, Alta., Will Serve to Show Something of the Progress and Development That is Taking Place in Our Western Cities. It will be Noted also That the Most Modern and Improved Equipment is Being Installed for the Several Purposes of Fire Protection, Light, Heat and Water Service.

LETHBRIDGE Municipal Power House is located on the bank of the river, 300 feet below the level of the city and about 1½ miles from its centre. It is a combination electric power and water works station, with a total capacity of 950 k.w. in two electric units, and four million gallons per day in three pumping units. The river affords an ample supply of condensing water at about 65 degs. F. maximum temperature. The city owns and operates a coal mine located about 1,500 feet from the power house. The coal is fair quality bituminous and the "run of the mine" has a heating value of approximately 10,000 B.t.u. The cost is $2 per ton in the bunkers.

Power House Building.

The power house building is of fireproof construction, 85 feet square, and the engine room ceiling is 35 feet high. The floors and roof are of reinforced concrete construction and the walls of brick. The engine room basement 15 feet deep, contains the condensing equipment, station transformers, rheostats, and waterworks pump.

Boiler Equipment.

There are four boilers of the Babcock and Wilcox water tube type, of 285 h.p. each, and fitted with Babcock chain grate stokers and superheaters. The working pressure is 155 lbs., with 130 degs. F. superheat. Ashes are dumped into a pit below the stoker, and automatically loaded on a bucket conveyor. The chain grate stokers are driven by a 5 h.p., 220 volt 2 phase motor.

Lethbridge Power Plant—Feed Pumps and "Lea Recorder" in corner.

Furnace Draft.

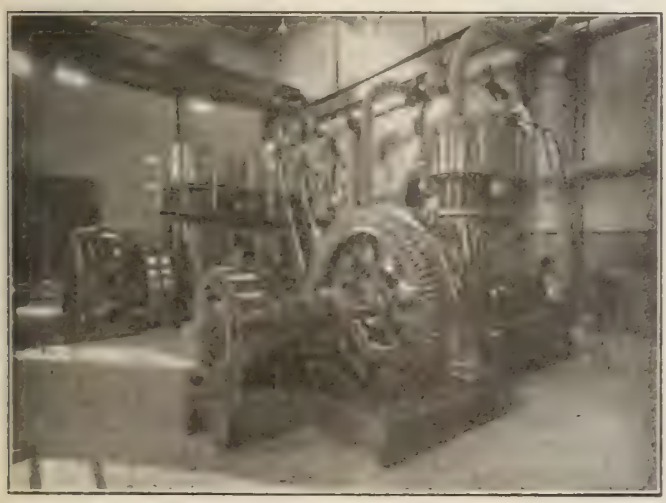
The induced draft apparatus is in duplicate. It was supplied by the Polson Iron Works, Toronto. and manufactured by B. F. Sturtevant. It consists of two vertical engines direct connected to "Multivane" fans running at about 100 r.p.m.; each fan being capable of handling draft for 1,500 h.p. The lubrication is automatic, and the bearing next to the fan casing is water cooled. Each engine is controlled by a Foster regulator guaranteed to maintain the steam pressure 1 per cent. above and below normal. Ellison differential draft gauges are fitted.

Economizer Equipment.

The economizer was also manufactured by B. F. Sturtevant and supplied by the Polson Iron Works, Toronto. It is capable of raising the temperature of 17,640 pounds of water per hour from 90 to 200 degs. F. The scrapers are driven by a 5 h.p. 220 volt, 2 phase motor. The feed water passes through an exhaust steam heater before reaching the economizer and after passing through the latter goes into the boilers at 250 degs. F. A special "Bristol" recording thermometer is fitted; this has two bulbs and pens, one connected to the inlet and the other connected to the outlet for the water. Both record on the same chart, and the diagram shows at any time the amount of heat put in the water by the economizer.

Coal and Ash Handling Equipment.

The coal and ash handling equipment consists of a Babcock and Wilcox "silent gravity bucket conveyor" hopper.



Lethbridge Power Plant—Engine Room, Showing 2 Generators, Piping and Overhead Crane.

Lethbridge Power Plant—South Side of Engine Room Showing End of Old Pumping Station and Outgoing Feeders.

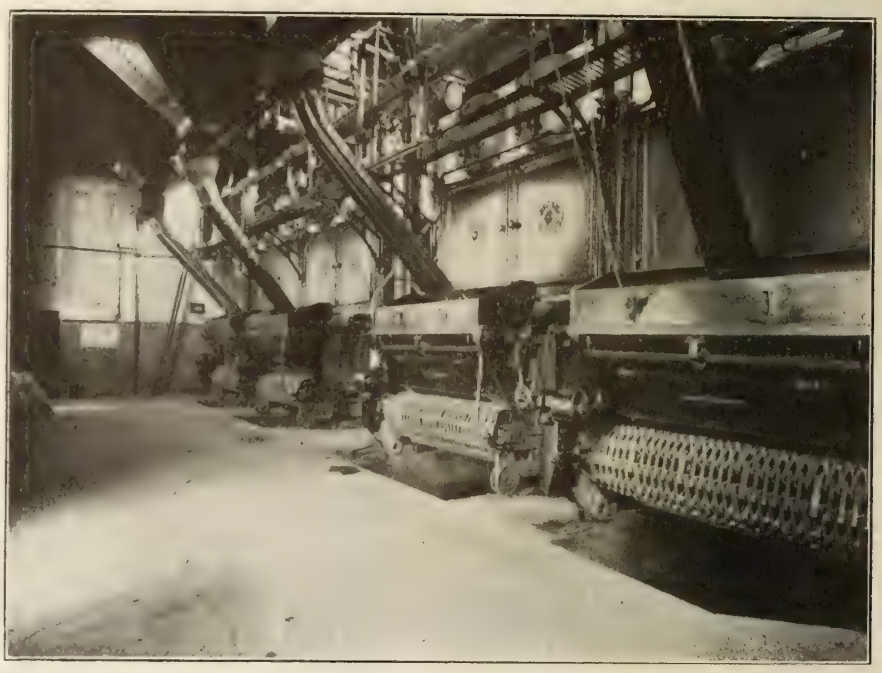
and coal crusher. The coal is dumped into a 10-ton hopper outside the building. From there, it passes through a jigging screen, the small coal being bypassed direct to the automatic filler, the lump coal going to the crusher and thence to the filler. The coal is next automatically dumped into the bunkers overhead. Automatic ash fillers are located at each ash pit, the ashes being raked from the pit into them and dumped into a hopper outside the building. Here, they are automatically loaded in cars and hauled away from the station. The conveyor has a capacity of 20 tons per hour and is driven by a 3 h.p., 220 volt, 2 phase motor. The crusher is operated by a 7½ h.p. motor.

Water Purifier.

A Lassen & Jhort water purifier is fitted, capable of handling 2,600 gallons of water per hour and of entirely removing all oil from the condensed steam. The water is pumped from the hot well by a Blake duplex pump to the purifier located on the fan gallery above the boilers, and is there treated with sulphate of alumina and soda ash. After being mixed with the chemicals, it passes through three filters in succession and finally flows by gravity through a "Lea Recorder" to the storage tank located in the engine room basement, beneath the feed pumps. The cost of purifying the water is approximately ¼ of a cent per 1,000 gallons. The purifier was supplied by the Babcock and Wilcox Co.

Feed Pumps.

The feed pumps are of the "Weir" vertical type supplied by Peacock Bros., Montreal. They are in duplicate, and each is capable of handling 40,000 lbs. of water per hour against a pressure of 160 lbs. They are located on the main floor of the engine room, and immediately above the water storage tank from which they draw the treated feed water. They also have a connection from the city water mains. Their steam supply is controlled by a "Fisher" governor.



Lethbridge Power Plant—Front of Boilers.

Engines and Generators.

The engines and generators are of the high speed vertical condensing type, manufactured by Belliss & Morcom, Birmingham, England, and supplied by Laurie & Lamb, Montreal. They consist of two units, one of 440 B.h.p. direct connected to a 350 k.w. 2,200 volt, 2 phase, 60 cycle generator, running at 360 r.p.m., and one of 720 B. h.p. direct connected to a 588 k.w. generator. Both generators were supplied by the Canadian Westinghouse Co., Hamilton. The exciters are direct connected to the generator shaft. A 30 k. w. motor generator set is also provided as a spare exciter; this is driven by a 2,200 volt 45 h.p. motor. The condensing equipment was also supplied by Laurie & Lamb, and consists of motor driven vertical centrifugal circulating pumps, and vertical motor driven air pumps. The condensers are of the surface type and guaranteed to maintain a vacuum within 2 inches of barometer. The exhausts are equipped with Worthington automatic relief valves to the atmosphere

Lethbridge Power Plant—Top of Boilers, Showing Bunkers, Fan Engines, Water Purifier

Piping.

The whole of the piping was manufactured by Stewart & Lloyds, Glasgow, Scotland, and supplied by Drummond, McCall, Montreal. The main steam piping on the loop system and 10 inches diameter, is fitted with automatic valves between each boiler and the main. All valves were manufactured by Glenfield & Kennedy, Glasgow, Scotland, and are of the gate type with outside screw and yoke. The whole of the steam and hot water piping is lagged with 2 inches of asbestos, covered with canvas and painted.

Switchboard.

The switchboard was supplied by the Canadian Westinghouse Co., and consists of 3 generator panels (one spare),

3 feeder panels, 1 lighting panel, totalling panel, 2 exciter panels, 2 station lighting and power panels. The totalling panel is equipped with 2 totalling ammeters, 2 ground detectors, 1 power factor meter, 1 Bristol recording voltmeter, 1 Graphic wattmeter, and 1 integrating wattmeter. All feeder panels are equipped with automatic switches and i.t.e. relays. A swinging panel carries the line and machine voltmeters and synchroscope. The panels are made of slate 2 inches thick, with black marine finish, and polished copper trimmings. A Terrill regulator controls the voltage.

Lethbridge Power Plant—Switchboard, Motor Generator Set and Piping.

Waterworks Pump.

The waterworks pump was manufactured by H. R. Worthington, Harrison, and supplied by the John McDougall Co., Montreal. It is of triple expansion duplex outside packed plunger type and has a capacity of 2,000,000 Imp. gallons per day against a pressure of 170 lbs. On test in the station, this pump developed a duty of 123,000,000 foot pounds per thousand pounds of steam with steam at 150 lbs. pressure and 100 degs. F. superheat and vacuum 25 inches. The air pump is direct connected to the rocker shafts operating the valve gear, and is of the vertical type. The condenser is located in the suction pipe and is guaranteed not to raise the temperature of the water more than 4 degrees.

Station Lighting.

The lighting and power for the station is supplied through 3-50 k.w. station transformers located in the engine room basement. The power is 220 volt and the lighting 110 volt. The main engine room is lighted by 16-100 Watt Tungsten lamps hung (above the crane) from the roof trusses. These lamps are equipped with aluminum cone wide angle reflectors and give a very even distribution of light. Four arc lamps hung on brackets from the wall, are provided for emergencies. Emergency lighting from the exciters is also provided.

Crane Equipment.

The overhead crane was manufactured by the Northern Engineering Co., Detroit, and supplied by Mussens, Ltd., Montreal. It is hand operated and of 30,000 lbs. capacity.

Operating Costs and Charges.

The electric lighting and power undertaking was purchased by the city from the Lethbridge Electric Co., in 1908. The preparations of plans for a new power house were immediately thereafter commenced, the firm of Smith, Kerry & Chace, Toronto, being engaged as consulting engineers. The first year of operation with the old equipment resulted in a loss of about $2,768 to the municipality, and a fire, which destroyed the old station and equipment on Dec. 31st, 1909, caused a complete change-over to the new station, then within two weeks of being ready for operation.

The first year's operation of the new station, under non-condensing and temporary piping conditions, resulted in a net profit of $30,864 after deducting all costs, including interest and sinking fund, but without allowance for depreciation. The expenses were reduced as follows:—Power house 37.8 per cent., and fuel 48.8 per cent. below that of 1909, although the output was 40 per cent. greater.

The lighting and power rates are as follows:—Lighting from 11c to 9c according to consumption, power by meter 7c to 4c and both subject to 10 per cent. discount at 10 days. Large amounts of power are sold on a flat rate basis of from $28 to $30 per h.p. per year. The first 6 months operation of the present year shows a net ptofit of $8,418, after deducting all costs.

Plans and specifications are now being issued for additional power units, consisting of 4 water tube boilers and 1,-500 k.v.a. turbo-alternator. Work will also be commenced on a street railway system at the beginning of 1912.

A BEAVER HOLD-UP.

WHEN the electric light in the prosperous city of North Bay first grew dim and then went out entirely, the indignant citizens turned as one man to the officials of the electrical development company which supplies the city with current, and demanded an explanation. An electric lighting system which needs a reserve of candles or coal-oil lamps, is not one of the civic assets to which a young and ambitious municipality can point with pride, and North Bay is too determined to keep abreast of competition to be facile in its requirements.

In the course of the investigation which immediately ensued, for North Bay is apparently able to have its public utility grievances looked into with a minimum of delay, it was discovered that the lack of electric power was due to low water, that the low water was due to beaver dams, and that the beaver dams were due to the game-protection laws which are enforced—here again we note a difference between North Bay conditions and those of other parts of Canada—in the Algonquin Park. The whole matter has, consequently, been transferred to the government offices at Toronto, where the case of the inhabitants of North Bay versus the beavers of Algonquin will doubtless be exhaustively argued and equitably decided. The significance of the case to other communities lies in the fact, that unless the beavers had been fairly well protected, their dams could hardly have interfered with the North Bay Supply of water-power—and if the beavers have been protected, it means that the game laws have been enforced.—Ex.

CUTTING OIL EXPENSE.

A monthly saving of $115 by scientific buying and use of lubricants in a single moderate sized mill is the estimate given in a recent report by Arthur D. Little, Inc., Chemists and Engineers, of Boston. In this case, the experts discovered a needless expenditure caused in the buying of oils and greases by branded name at prices a good deal higher than were necessary for thoroughly adequate lubricants. The estimated saving was based in large part upon the gain to be made by buying on specifications at reasonable prices; but a considerable part of the saving was also due to the stopping of oil waste by careless management on the part of engineers.

Power Appliances at the Canadian National Exhibition

The Recent Annual Canadian National Exhibition at Toronto was Well Up to Its Usual High Standard of General Excellence, and There was Much to Attract the Interest of Power Users and Operating Engineers. Inspection of the Mechanical Appliances was Largely Taken Advantage of, and Most of the Exhibitors Reported Numerous Inquiries and Sales.

LIST II.

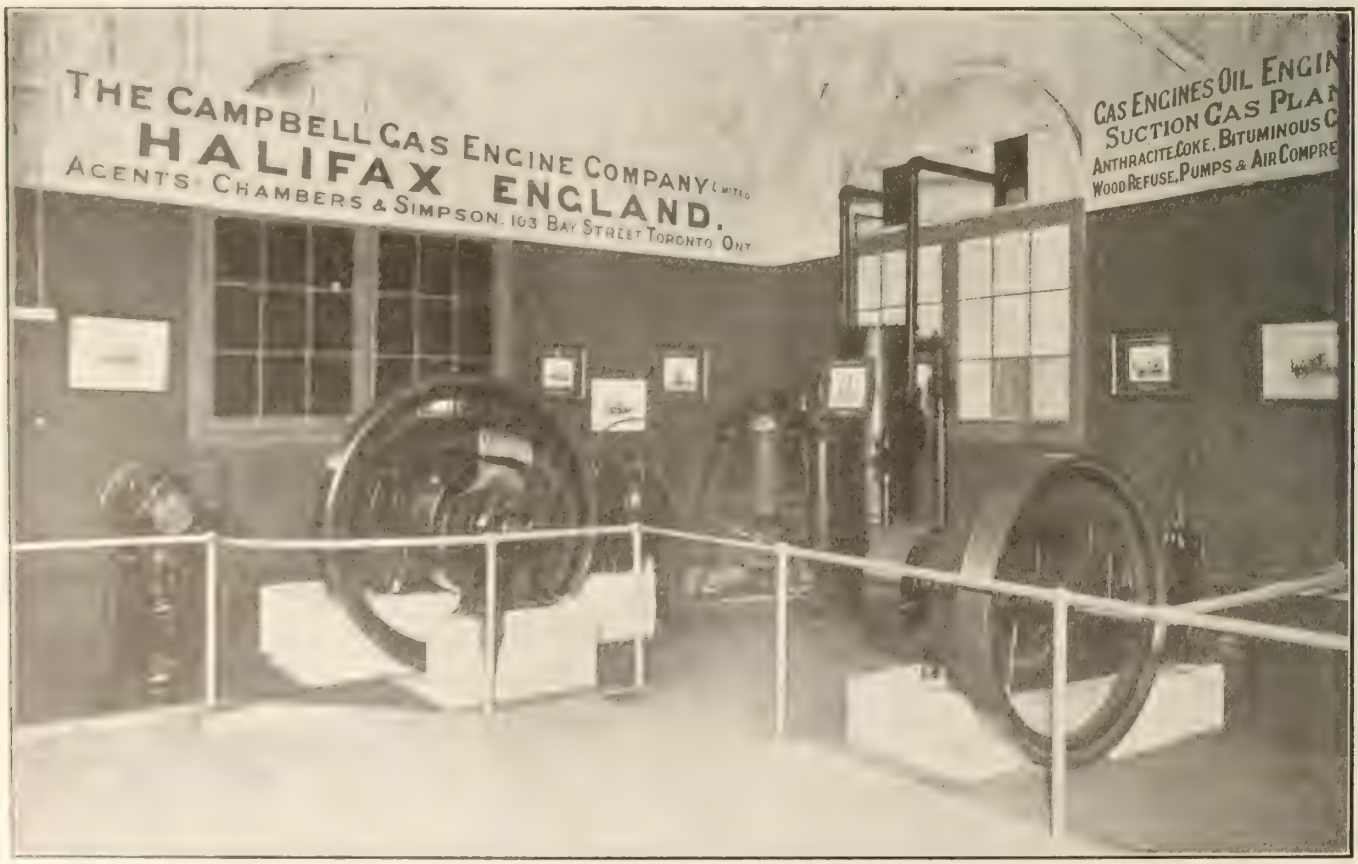
The Canadian H. W. Johns-Manville Co. had a large selection of their numerous asbestos products, including packing, roofing material, furnace cements, etc.

Laurie & Lamb, Montreal, exhibited a model of the latest type of refuse destructor, made by Heenan & Froude, Manchester, Eng. This method of disposing of town's refuse is much more widely used in Europe than it is on this continent. Laurie & Lamb have installed two sets in Canada, namely, at Westmount, P.Q., and Vancouver, B.C., and have orders on hand for similar installations at Ottawa, Moose Jaw and Calgary. In the Heenan & Froude destructor the garbage is introduced through a hopper at the top, from whence it falls on to a dead plate at the back of the grate. After remaining there for a few minutes to partially dry, it is raked forward into the trough-shaped grate and thoroughly consumed, the heat being used for raising steam or other purposes. The trough grate has perforated sides, through which forced draught is introduced. The hot gases, before reaching the stack, pass through a regenerator, which raises the air for combustion to a temperature of about 250 degrees Fahrenheit. The average temperature in the furnace is 2,000 degrees, and it is only by maintaining this intense heat that garbage can be successfully dealt with. Approximately one-third of the refuse comes out of the furnace again in the form of a hard clinker, and free of all organic matter. It has a definite commercial value, being largely used in concrete floors and other purposes. Heenan & Froude have introduced a simple mechanical clinker remover, which is generally used in combination with their destructors. The model was shown in an annex to the Public Health Exhibit, and, we fear, was missed by many visitors who would have been interested in it.

Jones & Glassco, Montreal, showed many artistically-arranged examples of the well-known Renold silent chain, for which they are sole Canadian agents. This chain is so well known to power users as to need no further comment. Kenyon's patent inter-stranded cotton driving ropes were also shown, Jones & Glassco being also sole Canadian agents for this specialty.

The Ontario Wind Engine & Pump Co., Toronto, showed a large number of Strickney gasoline engines. One of 7 h.p. rested on two rollers of iron pipe without being bolted down. In addition, it had the covers removed from both journal bearings, and ran all day with very little vibration. The governor can be adjusted while the engine is running, and has a wide range.

John Millen & Son, Montreal, had a large show case display of Coventry noiseless chain for driving purposes. Another prominent feature of their exhibit was a group of Cyclone high-speed chain blocks ranging in capacity from ½ to 40 tons. Hoffman ball bearings, Wright monkey wrenches and Stover pipe wrenches were also on view, the two lat-


THE CAMPBELL GAS ENGINE COMPANY (LIMITED)
HALIFAX ENGLAND.
AGENTS CHAMBERS & SIMPSON, 103 BAY STREET TORONTO ONT
GAS ENGINES OIL ENGIN
SUCTION GAS PLAN
ANTHRACITE COKE, BITUMINOUS C
WOOD REFUSE, PUMPS & AIR COMPRE

Campbell Gas Engine Co. Exhibit at the Canadian National Exhibition, Toronto, 1911.

ter items being very energetically demonstrated.

The Garlock Packing Co. had a full line of their well-known goods on show, also tube scrapers, etc. The booth was in charge of H. G. Fletcher, manager of the Toronto branch.

H. W. Petrie, Ltd., exhibited three gas engines made by the Keighley Gas & Oil Engine Co., England. All were operating on suction gas, generated in a producer by the same firm. The largest engine was of 65 B.h.p., the others being 30 B.h.p. and 12 B.h.p., respectively. A high-class display of machine tools and accessories added to the further attractiveness of this exhibit.

The H. W. Petrie Exhibit of Keighley Gas Engines at the Canadian National Exhibition, Toronto, 1911.

The Campbell Gas Engine Co., Halifax, England, showed a 25 B.h.p. gas engine running on suction gas, and a 13 B.h.p. engine operating on coal oil with tube ignition. Chambers & Simpson, Bay Street, Toronto, are Canadian agents for these engines.

The General Supply Company of Canada had a comprehensive exhibit, which included Smart-Turner feed pumps, Dart unions and machinists' vises, as well as a number of types of gasoline-driven pumps for farm and domestic use. Their largest exhibit was a 25-in. engine lathe of the Leblond type, built by the London Machine Tool Co., Hamilton, Ont.

FUEL OIL PRECAUTIONS.

By C. T. R.

THE great prominence of fuel oil in marine service has led the United States Navy Department to issue the following instructions and precautions, as necessary to be followed and taken by those who use it on board ship. It seems, therefore, not amiss to bring the matter to the attention of engineers in stationary power plants, particulatly as its use in these is likely to be more largely taken advantage of in the near future. We are indebted to the Hydrographic Bulletin for the details.

General Data.

Fuel oil as supplied to vessels of the navy is the residue of crude oil after the removal, by distillation, of sulphur and volatile oils and gases. It is inert, non-explosive, very difficult to ignite in bulk, and not capable of spontaneous combustion. The vapor from this oil is, however, explosive when mixed with air, and being heavier than air, tends to accumulate in low levels such as bilges and bottoms of tanks, where it may remain undiscovered until ignited by a naked light or spark. This vapor is always present in a partly filled oil tank, or in a tank which has contained fuel oil and from which the vapor has not been removed by artificial means. It is given off through the vents, from tanks in process of being filled.

A leak in any part of the oil-burning system may, if allowed to continue, result in an accumulation of explosive vapor, unless the leak be located in the path of air to the furnace. Ignition of the vapor has been caused by an open light, electric spark, smoking, spark caused by striking metal, heat from the filament of a broken electric lamp, sparks from funnel, or has been communicated from the galley or the fires under boilers.

An oil fire cannot be extinguished by water, but may be extinguished by sand, steam, or chemical fire extinguishers. An intelligent appreciation of the properties of fuel oil as described above is a better preventive of accident than adherence to any set of rules that may be prescribed.

Precautions

The following detailed precautions will, however, be rigidly enforced:

1.—When oil is being received on board, no naked light, smoking, or electrical apparatus liable to spark will be permitted within 50 feet of the oil hose, tank, compartment containing the tank, or the vent from the tank.

2.—While receiving fuel oil the storage tank must be closely watched for leaks, and care must be taken that all outlets from the tanks except the vents are closed.

The H. W. Petrie Exhibit of a Keighley Gas Producer at the Canadian National Exhibition, Toronto, 1911.

3.—No naked light, smoking, or electrical apparatus liable to spark shall be permitted at any time in a compartment containing a fuel oil tank. Electric lamps used in such compartments shall have wire protectors around the bulb, or shall be of a type that will insure the breaking of the circuit through the lamp in the case of breaking of the lamp.

4.—No one shall be allowed to enter a fuel-oil tank until it has been gas freed by the use of steam, and any person when entering the tank must have a life line around his body, properly tended, in order that he may be hauled out if overcome by gas.

5.—Smoking, electrical fuses, and switches, unless of the enclosed type, shall not be permitted in compartments containing fuel-oil pumps or piping, except that smoking may be permitted on the fire-room floor plates in front of the furnaces.

6.—Care must be taken that the wire-gauze protectors in vent pipes from fuel-oil tanks are at all times intact, and smoking will be forbidden in the immediate vicinity of these vents.

7.—Dampers in the uptakes of boilers must be kept full open while burning oil. Otherwise there may result dangerous accumulation of gas in the furnace with a resultant backing out into the fireroom.

8.—The valves on glass gauges on fuel-oil storage or settling tanks shall be kept habitually shut. When a reading of the gauge is desired, the valves may be opened, but must be at once shut again.

9.—In each fireroom fitted for oil burning, there shall be fire extinguishing apparatus, consisting of:—

Steam fire hose, permanently coupled and of sufficient length to reach all parts of the fireroom, and either:—

(a) A box containing about two bushels of dry sand with a large scoop, or

(b) Chemical fire extinguishers of the tank type.

10.—When the fuel-oil system has not been in use for a period of a week, or after joints in the piping have been remade, the system shall be tested cold, under pressures at least equal to the working pressures, before fires are lighted. During this test there shall be careful inspection for leaks.

11.—Fuel oil will not habitually be heated above 150 deg. F., and never above the flash point in any part of the system except in the burners.

13.—Care must be taken to prevent the accumulation of oil or vapor in any place outside the system, particularly in bilges under the furnace. This can best be accomplished by rigid cleanliness.

14.—In the event of a considerable accumulation of oil in the furnace, such as may be caused by a sudden extinguishing of the burners, the vapor must be blown out through the smoke pipes by steam hose before fires are again lighted.

15.—For lighting the burners, a piece of burning waste on the end of an iron rod about four feet long is recommended. This is to protect the fireman from a back flash.

CORROSION AND PITTING.

A recent invention to overcome troubles of corrosion and pitting in metals, especially in boilers, due to electric chemical action of ingredients in water with which they are brought in contact, appears to have met with success in Sydney, Australia. The plan of the invention, according to The Engineer, is to introduce by dynamos electrical currents onto the metals to be protected, thus neutralizing the galvanic action of the corrosive substances contained in the water. The invention is expected to make an immense saving by eliminating the necessity for using zinc in various forms, boiler fluids, etc., to combat corrosive tendencies, and also in dispensing with retubing and other repairs. The process has been tried with success at Malvern University.

N. A. S. E. ENTERTAINED BY THE LUNKENHEIMER CO.

THE feature of the twenty-ninth annual convention in Cincinnati, of the National Association of Stationary Engineers and its kindred organizations, was the river ride and outing at Coney Island, when more than 3,000 engineers and exhibitors, their wives, sisters, children and sweethearts were the guests of the Lunkenheimer Company. It was one of the biggest picnics in the history of Coney Island, and the most elaborate entertainment ever afforded a convention of the N. A. S. E. since its organization.

Practically every delegate and stationary engineer in the city and the members of their families assembled at the Sinton Hotel at 8 o'clock in the morning and headed by Esberger's Band, marched to the foot of Broadway, where they boarded the steamer Island Queen. When all were on board the boat was crowded to the limit authorized by the Government. Others, unable to leave so early, joined the crowd at Coney Island in the afternoon.

The morning was spent in a ride down the river, which was featured by whistle salutes from boats and factories all along the line. It was intended to visit Fernbank Dam, but, owing to a late start, it was impossible for the boat to make the trip and return to Coney Island by the time set for the big barbecue and burgoo which was scheduled for the noon hour. The trip down the river extended to within four miles of the dam, however, and was greatly appreciated by all the guests.

Jones & Glassco Exhibit at the Canadian National Exhibition, Toronto, 1911

Feed Water Heaters*

By D. K. Dean.**

THE tubes, however, must be of sufficient diameter to prevent chattering. Heat transmission is not as high as might be expected with smaller tubing, this heater is not suitable for waters which contain a scaling content, because of the difficulty of cleaning.

In all the foregoing types, differences in expansion and contraction of the tubes and shell, are accommodated within the tubing itself, so that no other special provision is necessary.

The Straight Smooth Tube Heater.

The use of a straight tube, makes possible this type of heater, in regions where the feed water contains large quantities of scaling content. It is however, necessary to provide some special means for accommodating expansion and contraction. With one type, this is accomplished by allowing the tube to pass through a packed gland at one end, as in condenser practice. This is good, if the glands are deep and the packing of a type which will stand the high pressures and temperatures without leakage and deterioration.

A second type of straight tube heater, is that in which the tubes are expanded into a rigid tube head at one end, and into a moveable head at the other. With this construction, the movable head and the tubes are subjected to strains set up by the unequal expansion of the various tubes, which consequently must be of large diameter and heavy gauge. Further, full boiler pressure exerted on an area, equivalent to the full area of the tubes, tends to force the movable head off the tubes and puts further strain upon them.

The Straight Corrugated Tube Type.

In this type, straight tubes of small diameter, corrugated throughout their whole length are expanded rigidly into both tube heads which are attached rigidly to the shell. Differences of expansion and contraction of the tubes and the shell are accommodated within the corrugation of the tubes. The chief advantage of the corrugated tube, is that the water is agitated to the fullest extent in such a manner as to bring the various particles of the stream in most intimate contact with the heating surface, thereby securing a maximum rate of transmission for a given amount of heating surface. The tubes are arranged in nests so that the water passes through the several groups in succession. A high velocity is secured.

Again, the surface velocity is as high, or higher than the average velocity of the stream. Hence the tendency of impurities to collect upon the heating surface is reduced to a minimum. This type of heater is particularly adaptable for use in bad feed water districts.

Heating Surface in a Closed Heater.

The transmission of heat through the walls of heater tubes is proportional to the difference between the temperature of the steam on one side of the tube, and the water on the other side. It is generally assumed that the temperature of the steam will be the same throughout the heater.

Open Versus Closed Heater.

The two general types perform their functions in a manner vastly different, consequently, each has several virtues which the other is devoid. This results in the choice of one type or the other for a given set of conditions, and is largely dependent in its finality upon personal preference. It is a fact also, that the proper operation of either type results from the correctness of the design of the power plant, and the attention which is given the heater in operation. The personnel of the engine room is often a large factor in determining the choice of one type or the other.

Saving of Heat Effected.

If an ample supply of steam be provided, one type is as good as the other, as far as the saving of heat alone is concerned, providing of course, that there is sufficient heating or tray surface to accomplish the desired result. If the supply of steam is sufficient to heat the water to within a few degrees of the steam, probably a little greater heat saving may be effected by the open heater, since the heating steam condenses and becomes a part of the feed water. The saving effected by this means in the open heater is, however, but slightly greater than in the other type, since, in the closed heater, if there be an insufficient amount of steam, not only will the latent heat of steam condensation be removed, but also a large part of the heat in the condensed water as well, particularly if the arrangement of heating surface is such that the condensed water must drip over the cool tubes on its way to the drain connection. With a straight water-tube type of closed heater, in which the flow of the water opposes that of the steam, the temperature of the drop may be lowered to within about ten degrees of the temperature of the inlet water, if the steam supply is insufficient to keep the heater shell filled with vapor.

Assuming an inlet water temperature of 50 degrees, and exhaust steam at atmospheric pressure as the heating medium, each pound of steam condensed in an open heater, effects a saving of

1146.6—(50—32)=1128.6 B.t.u.

In a closed heater, if the temperature of the condensed water be lowered to within ten degrees of the inlet temperature—50 degrees, the saving per pound of steam would be

1146.6—[(50—10)—32]=1118.6 B.t.u,

which is slightly at a disadvantage compared with the saving to be effected in the open heater, unless, of course, the condensed water is returned to the boiler after passing from the feed water heater, in which case, the heat saving of the two types would be the same.

Saving of Condensed Water

The argument is often put forth that the open heater saves the condensed water necessary to do the required heating, and that it, therefore, has this considerable advantage to offer as opposed to the closed type. It is a fact, of course, that the condensed water mixes directly with the feed water. It is, however, usually undesirable to permit this, since the steam for heating purposes is generally taken from the exhaust of auxiliaries, in which large quantities of cylinder oil are used. While a separator will remove a large part of the oil, it cannot be expected to abstract every trace.

If it is desirable to save the condensed water, it is easily possible to do so with the closed heater. The water may first be passed through a filter and the oil effectively removed to a large extent, before mingling with the main body of the feed water. By filtering the small quantity of condensed water, a much greater perecentage of the oil can be removed than by filtering the whole body of the feed water, as is the case with the open heater, since in the latter, while the amount of oil to be removed is the same, the density of the oil solution, if it can be called such, would be only about one-sixth as great as would be the case in the condensation from a closed heater, and therefore, it would be much more difficult to remove the oil in the open than in the closed type.

Exhaust Steam Feed Water Heater as a Purifier.

The beneficial results to be derived from the use of the exhaust steam feed water heater as a purifier are often exaggerated. It is true, of course, that the heating of water will cause the precipitation of impurities, which at low temperatures may be soluble. It is also true, that only one class of impurities ordinarily found in feed waters is rendered insoluble by heating to the temperatures of exhaust steam. Of the impurities ordinarily found in feed waters, calcium and magnesium carbon-

*Continuation of Paper read at the C.A.S.E. Convention, Stratford, Ont., July, 1911.

**Of the Alberger Condenser Co., New York.

ates are the most common. Next in order are the sulphates. The carbonates are rendered insoluble at about 200 degrees, and the sulphates and other impurities at about 300 degrees and above. The carbonates are held in suspension in water by free carbon dioxide in solution. When this water is heated to 200 degrees, the carbon dioxide is driven off and the carbon is precipitated. In order that all the carbonates in a given sample of water may be precipitated, it would require that the water should remain at the high temperature for about thirty minutes.

Except in the steam-tube type of closed heater, which has been shown to be particularly non-adaptable to bad water conditions, the water remains in the heater only about a minute at the most. It is, therefore, obvious that but little can be expected from this type of heater in the way of purification, advertising literature to the contrary, nothwithstanding.

In the open heater, however, the water remains in the storage at the bottom of the heater for a longer time. Hence, somewhat better results are to be expected. The storage space here is not sufficiently ample to effect much in the way of purification. At best, the water is not in storage more than eight minutes, and consequently only a small portion of the total lime content is precipitated in the heater. With the open heater, this purifying effect is offset by the fact that oil is introduced into the feed water.

The dangers and troubles arising from oil in feed water are not ordinarily appreciated. Oil is lighter than water, consequently when it is supplied to a boiler, it does not find its way to the mud drum, but collects on the water level, or on the contiguous surface. When heated to boiler temperatures, volatile hydro-carbon are driven off, and if the film of oil covers a part of the heating surface, this film becomes an excellent heat insulator, preventing the water from cooling this portion of the shell or tubes, as the case may be. Bulging of this part will follow, and unless this defect is remedied, a blow-out will result. Nor is this the only evil with which to contend, if oil be present in feed water. Many oils, particularly those classed as animal oils, are decomposed at boiler, or even cylinder temperatures. This results in the setting free of fatty acids which may attack all surface with which the steam comes in contact. Also if these acids be introduced into water containing a lime content, the scale which would form, instead of being soft and easily removable, as ordinarily would would be the case, would be rendered hard and removable only by means of a special tube cleaning device

THE HYDRAULIC RAM.*

THE principles underlying the construction and operation of the hydraulic ram were recognized as early as 1775 by John Whitehurst, who in that year communicated to the Royal Society a paper describing a machine of a simple type in which the overflow or waste valve was operated by hand. The next improvement was made by a Frenchman, Joseph Michael de Montgolfier. He was the first to see that the variable pressure, produced by changing the velocity of a column of water, could be utilized to operate the valve. Since that time, although numerous improvements have been made in the way of securing quick action of valves by aid of springs and weighted levers, the ram is essentially the same as in its earliest form.

A drive pipe, A Fig. 1, takes water from a source of supply H, to a chamber which contains the valve V_1. This valve, which opens inwardly, is called the waste or overflow valve. In another part of the same, or communicating chamber, is a check valve V_2, which leads to the tank into which water is being forced and which has a water level considerably above that of the supply tank. When V_1 is opened, the column of water in the drive pipe is set in motion, and will finally attain a velocity which builds up a pressure under V_1 sufficient to close the waste valve. The energy of the moving mass in the drive pipe cannot immediately be dissipated, therefore, the pressure in the chamber rises and lifts the check valve, allowing some of the water to enter the air chamber W, compressing the air and forcing an equal amount of water into the tank C. When the water in the drive pipe comes to rest, V_2 closes, V_1 opens and the cycle is repeated. The pressure may for an instant be slightly less than atmospheric, and advantage is taken of this to introduce a small amount of air through an air valve. This air replenishes any part of the supply in the air chamber which may be carried out with the water.

Although the ram may have a high efficiency, it is wasteful of water, and the form shown in section in Fig. 2 has been devised to pump pure water with a minimum of waste. A is connected to the source of waste water, which may be any polluted water available. I is the connection to the potable water which should preferably come from a source under slightly greater head than the impure water. In this ram the waste water consists mainly of that entering at A but, in part from that entering at

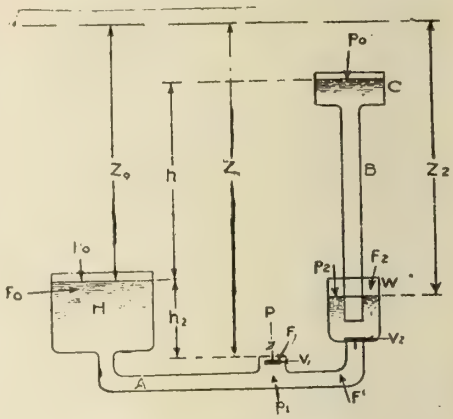


Fig 1.—Diagram of Operation of Hydraulic Ram.

I, and if the capacity of the space between the waste valve B and the check valve C is greater than the amount of water delivered per pulse, no impure water can enter the chamber D. In this ram the air valve is placed at E.

The hydraulic ram lends itself readily to variable demand, which can be met by either changing the weight of the waste valve or adjusting its stroke. Its greatest field is in the water supply for small towns where the cost of maintenance and attendance must be kept as low as possible. A recent installation, in a town of 1,600 inhabitants, supplanted a steam pumping outfit where the daily cost of operation was $25.00. The only attention which the ram required was occasionally renewal of valve discs.

*From a paper by Leo Loeb in The Polytechnic

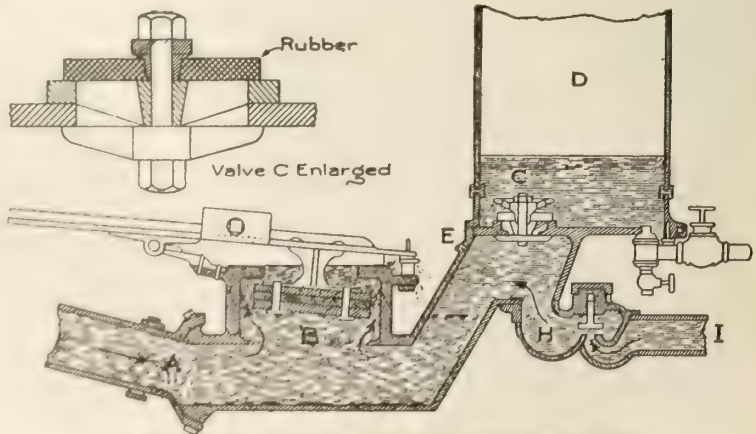


Fig. 2.—Section of Double Supply Hydraulic Ram.

Applicability of the Chain Drive to Power Transmission

By C. T. R.

The Writer Points Out the Particular Circumstances Which Led to the Introduction of Chain Driving for Power Transmission Purposes, the Conditions Under Which It is Not Possible to Make Use of the System, and Details the Special Features Which Have Contributed to Highly Satisfactory Results in Numerous Installations.

NOW, that electricity is being so largely utilized by manufacturers and power-users in Canada, it is necessary to consider carefully the question of methods of transmission, because of the fact that this governs to a lesser or greater extent, the difference between the cost per horse power charged by the Power Co., and the cost per useful or productive horse power at the machine. Hitherto, the steam, gas or oil engine has provided a margin of power generally sufficient to cover losses in transmission without showing any increase on the power bill; but as power companies charge for the current taken by the motor and not the actual horse power at the machine, then, unless the transmission is efficient and the frictional losses low, hundreds of dollars may be paid each year for something which is not available for production purposes.

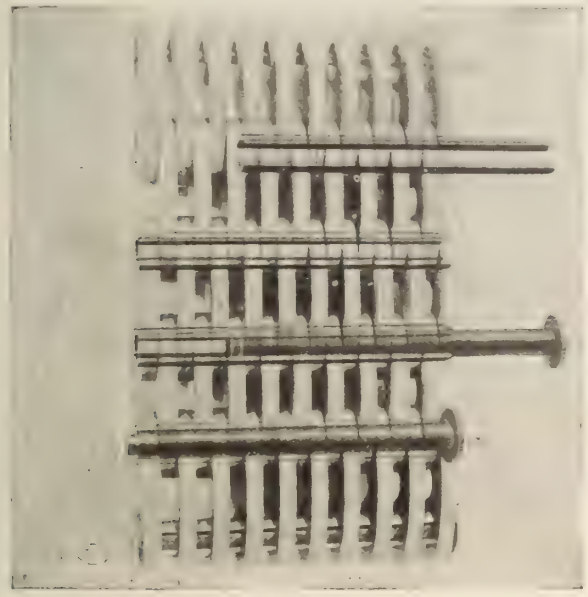


Fig. 1—Hans Renold Patent Liner Silent Chain.

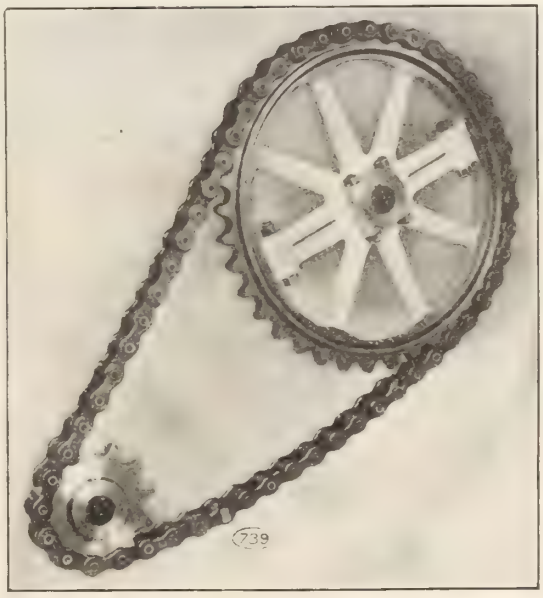


Fig. 2—Bush Roller Chain Drive for Heavy Loads and Moderate Speed.

Chain Drive Limitations.

There are many locations and conditions, particularly suited for belts, ropes and gears, and these systems will never be discarded; yet as the system of power transmission by chain has become more widely known, its advantages have been quickly appreciated and its popularity greatly increased among prominent Canadian firms. Chain driving of course has its limitations; for instance where power has to be transmitted at right angles, or where the driving and driven shafts run in opposite directions. This latter instance in itself debars its use on fully half the machine tools in service, and where otherwise it would be applicable. Chains are not affected by moisture, heat or oil; belts and ropes tend to slip under such conditions, with resultant loss of power accompanied by destructive heat. It was, however, in cases where shafts were too far apart for gears and too near for belts or ropes that chains made their debut. Their success in these fields, suggested trials in others.

Some Types of Chain for Power Transmission.

Fig. 1 represents the patent liner silent chain for speeds up to 1,300 ft., and having special provision for lubrication at still higher speeds.

Fig. 3 represents the bush roller chain for speeds ranging from 400 to 900 ft. per minute.

Fig. 2 represents the bush roller chain for speeds up to 400 ft. per minute.

In each type, the links of the chain are blanked from steel strips of high tensile strength, and the bearing surfaces are of case-hardened steel. Briefly put the patent silent chain is suitable for practically all classes of high speed drive, the roller chain for heavy moderate speed drives as for automobile transmission, and the steel block chain to the

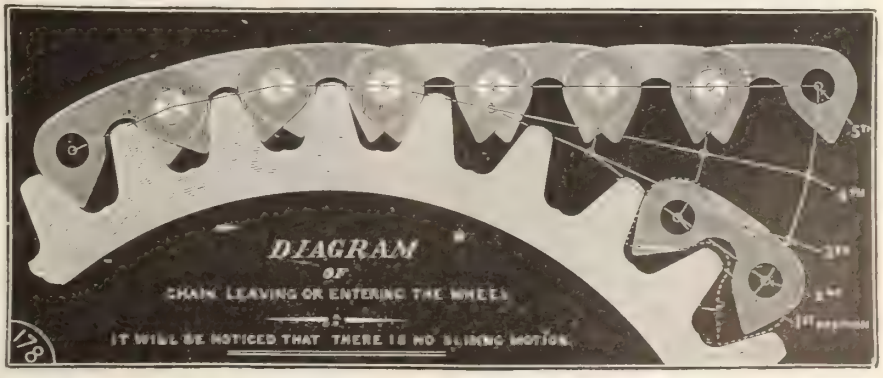


Fig. 1a

variety purposes for which the malleable ink chains have hitherto been used. In the present article, attention is directed only to the patent liner silent chain, on account of its being especially suitable for use in conjunction with electric motors. Figs. 1, 2, 3, 4, 5, 6, 7 and 8 show typical

derstand that there were drives installed in Canada 5 years ago, and still in service, which originally replaced other forms of transmission that could not stand the severity of the load and continuous service. These drives have been running regularly night and day, and

Design.

The success of a chain drive is of course essentially a function of the design and material of construction. In a well designed gear, the action of the chain entering the wheel is purely a roll-

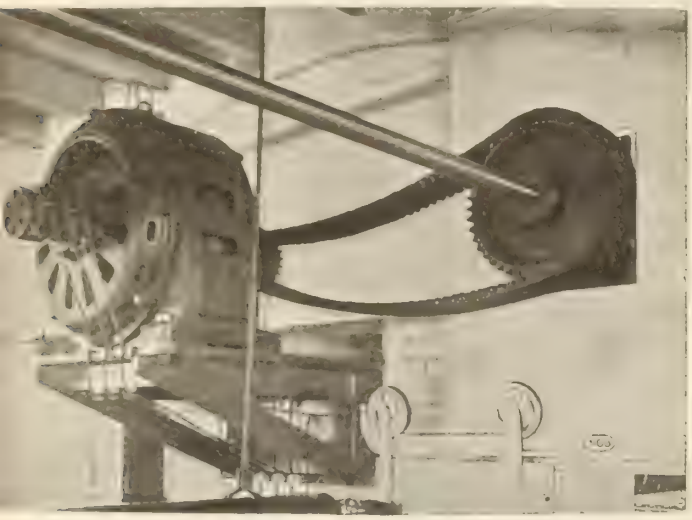


Fig. 5 — Typical Silent Chain Drive from Motor to Lineshaft.

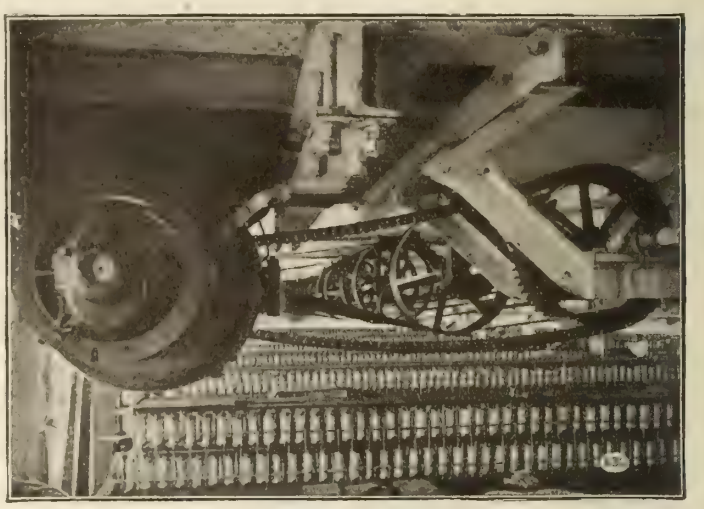


Fig. 6 — 60 H.P. Lineshaft Drive from Motor in Flax Spinning Mill, by Silent Chain.

applications. The advantages claimed for the patent liner silent chain are briefly as follows :

Efficiency.

The efficiency is high, and moreover, is constant throughout its life. The principle of the chain is that of tooth gearing, and all possibility of slip is eliminated. Journal friction, i.e., loss of power, is a minimum, as the chain can be run practically slack on the wheels. With belts, considerable tension is frequently necessary, and particularly so with the small pulleys of high speed electric motors.

Durability.

This is largely governed by the conditions of each particular drive. We un-

apart from receiving lubrication, have not given any trouble. Other drives have been in regular service upwards of seven years, and with improvements in design and manufacture since then, even better results may be expected. Chains wear of course, after continuous service, but for the reason that they automatically rise on the wheel teeth as the pitch increases, the efficiency keeps constant.

Quiet Running.

In many instances, the gear makes no greater sound than a medium sized belt. It is impossible to have metallic pieces moving with absolute silence, and its degree is affected by the speed of the chain and the number of teeth in the sprockets. Noise is only produced when the chain speed is excessive, and when the number of teeth becomes very low.

ing one, see Fig. Ia, and except on wheels with exceptionally few teeth, sliding and hammering may be practically eliminated. The strength of a chain depends more upon the bearing area (see fig. 1) of the studs connecting the links, than any other feature, and this should be ample with the load distributed. The material of the wheels should be influenced by the ratio of the speeds between the driver and driven shafts, and should be such that the wear on each wheel is the same. The life is considerably shortened if the wear on the wheels is not proportional.

Compactness.

This is probably one of the most important advantages chain transmission offers over belts or ropes, and it secures admission for the system into an unlimited field of application. The chain

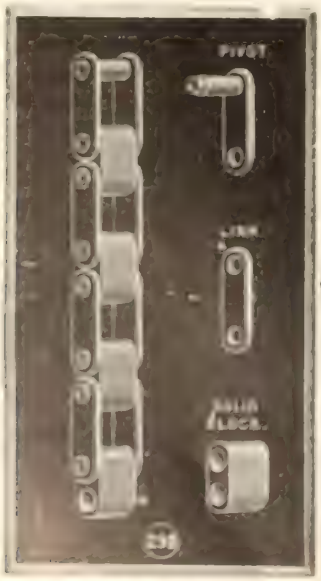


Fig. [illegible] Steel Inserted Chain Used for a Variety of Purposes.

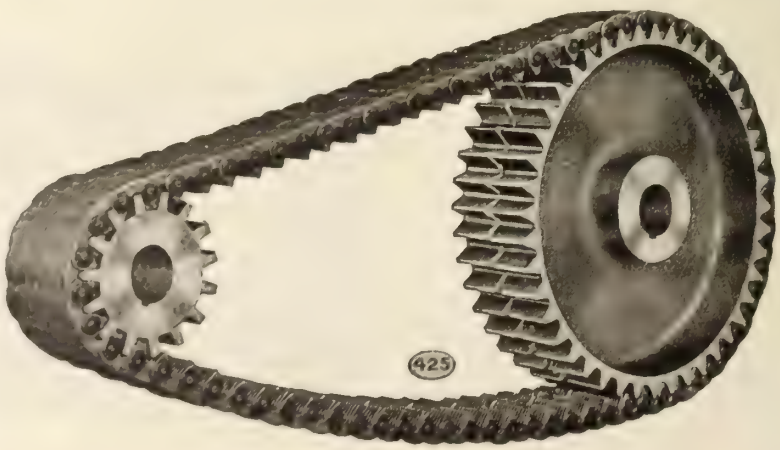


Fig. 4 — A Typical 65 H.P. Silent Chain Drive. Wheels 15 and 65 T. Diameters, 7.5" x 31.25". Chain, 1.5" Pitch, 6" wide. Shaft centres, 5 feet.

sprockets are approximately one half the size of belt pulleys of the same capacity, and they may be placed quite close together, thus economizing in space, and often providing a more convenient and satisfactory arrangement of machines. Again, the width of the chain is usually about one third the width of a belt for the same power.

To many, the first cost of a chain drive is an obstruction ; this being about 50 per cent. for small powers, and as low as 35 per cent. for large powers,

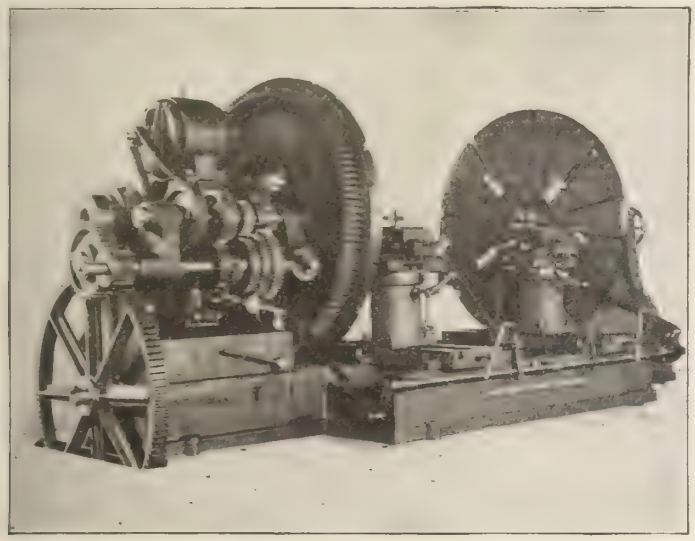


Fig. 7 — Lathe Drive from Motor by Silent Chain.

higher than a belt drive of equal capacity. It should be borne in mind, however, that higher efficiency, saving in power and increased production, mean more satisfactory transmission, at low cost. There are several hundred chain drives in use in Canada, a large majority of which are transmitting upwards of 200 h.p., with centres as short as six feet. Undoubtedly, as the system becomes more widely known and its advantages realized in actual service, adaptation will become much more general.

For the illustrations shown in this article we are indebted to Jones & Glassco, Montreal, the Canadian Agents for Hans Renold, Ltd., Manufacturers of chain driving gear, of Manchester, England.

BOTTLED SUNSHINE.

When a man in the States makes up his mind to "get on or get out," his efforts to get-rich-quick are a perfect godsend to the financial specialists in this line. Two such specialists have recently obtained $1,000,000 from persons in a hurry to speculate on "bottled sunshine." The imposture shows commercial enterprise worthy of a better cause. The organizers duly worked up their publicity department, "plants were erected in New York, Philadelphia, Baltimore and other cities." Each "plant" comprised a series of mirrors to catch the sunshine, wires carried the energy from the mirrors to certain storage jars; to these jars incandescent lamps were connected. When the sun shone the lamps lighted up beautifully; it was marvellous how those little mirrors could keep a great bank of lamps going. Even quantitative data were supplied to that one, one sunny day would light any office building for a week. Some fool of an electrician must have thrust himself in, however, and before the patentees could get aboard the lugger with their swag, the Federal authorities laid hands upon them.—Meteor. E. T.

A NEVER-STOP TRAIN.

A new system of tube railways was explained to the engineering section of the British Association at its meeting in Portsmouth recently. At first sight it seemed as if the scheme unfolded by an American engineer, Mr. Yarath Lewis, must have some radical flaw in it, but when men like Prof. Coker, Captain Sankey, Prof. Dolby, and Charles Hawksley discussed it seriously, the interest and importance of the proposal became evident.

Briefly, the idea is to have cars attached at short intervals to a screw-shaft running the whole length of the line. On the shaft the thread is varied—between stations it is extended, at stations it is compressed. The cars, therefore, slow down when they reach a station, but do not stop. At a speed of three miles an hour they pick up passengers as they go along. No brakes or signals are required.

The speed, it is estimated, would be 25 per cent. higher than in present tube railways, the initial cost only half as great, and the working expenses smaller. The shaft would be worked by power stations at fairly frequent intervals.

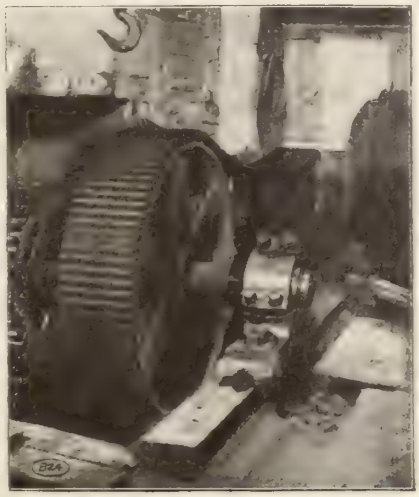
Mr. Lewis pointed out that in London, a street journey of two miles could only be accomplished at little more than double a fast walking pace, and added that evidently some better system was required. The engineering advantage of the scheme is that there is no "dead stop" of energy, since when the train halts at a station, the slowing up of the cars helps to wind the screw and returns 80 per cent. of the energy expended in speeding up. The system, it was mentioned, can be seen in operation at Messrs. Ransomes' works at Ipswich.—Ex.

FAILURE OF A BRAZED JOINT.*

By Professor Henry Louis.

THIS paper deals with the failure of a brazed joint on a steampipe aboard the steamer "Lord Cromer," when carrying a pressure of about 175 pounds per sq. inch. The pipe was of copper, 5½ in. internal diameter. It was

*Paper read before the Institute of Metals



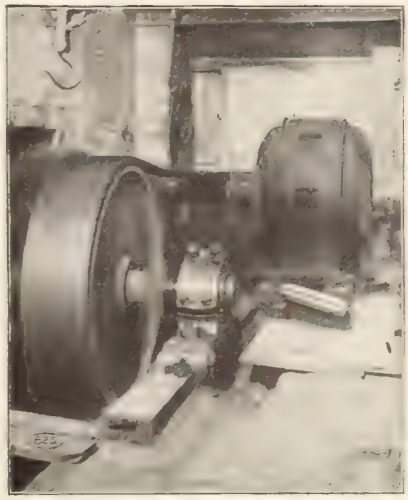


Fig. 8.—Silent Chain Transmitting 150 H.P. in Crushing Plant for a Brick Mill.

found that the explosion was due to the opening up of the longitudinal brazed joint for a length of 3 ft. 6 in. The braze was found to be extensively corroded, especially on the inner surface of the pipe, and the author was requested by the Board of Trade to investigate the cause. The braze was a bevelled joint, ¾ in. long, and nearly ⅛ in. thick in places. It was stated to have been made in 1897, with spelter having the following composition :—Copper, 52.68 per cent., zinc, 46.83 per cent., and tin, 0.49 per cent. A section showed that the outer portion of the joint for about half its length was sound, apparently unaltered, whilst the inner portion had been greatly attacked. It had become copper colored, and could easily be broken up or detached from the copper tube. It showed numerous cavities and fissures, containing apparently basic salts of copper and zinc.

An analysis of the sound portion of the brass gave :—Copper, 66.60 per cent., zinc, 31.30 per cent., tin, 0.77 per cent., lead, 0.40 per cent., arsenic, antimony, iron in traces, and oxygen and loss, 0.63 per cent. The corroded portion was found to contain :—Copper, 78.40 per cent., zinc, 13.50 per cent., tin, 0.78 per cent., lead, nil, arsenic, antimony, iron, in traces, and oxygen and loss, 7.32 per cent. The brass was polished and etched with a 10 per cent. solution of hydrochloric acid, and under a high power the crystals of brass were seen to be separated by a fine network of whitish alloy. All the fissures and fractures of the corroded brass had exactly followed these reticulations, and it was obvious that they had formed lines of weakness, along which corrosion had taken place. If it had been possible to prevent these reticulations, in all probability the corrosion of the material would have been prevented to a great extent.

Cause of Reticulated Structure.

In order to determine the cause of this reticulated structure a series of alloys was made up as follows :—(a) Pure brass, containing 2 of copper to 1 of zinc ; (b) the same as a, with the addition of 0.75 per cent. of tin ; (c) the same as a, with the addition of 0.5 per cent. of lead ; and (d) the same as a, with the addition of 0.75 of tin and 0.5 of lead. These were etched in the same way as the original brazing. Dilute hydrochloric acid had very little effect on brass, but it was found that by gripping the button of brass in close metallic contact between the jaws of a copper clip, the brass was attacked quite readily, and that results strictly comparable with those of the original brazing were obtained. All the above alloys, when quickly cooled, showed a fine-grained crystalline structure, quite different to that of the brazing ; on being annealed at 800 deg. C. for half an hour the typical brass structure was developed, there being no indication of any segregation around the crystals of the pure brass, though well marked in alloy (d). The same results were obtained by remelting under borax, followed by slow cooling, but the most marked results were obtained by remelting under charcoal and allowing to cool slowly. The pure brass still showed none of this reticulated structure, although there were indications of it in alloys (b) and (c), and it was extremely well marked in alloy (d). The author, therefore, had no doubt that this appearance was caused by an alloy consisting essentially of lead and tin, much more fusible than brass, which solidified about the crystals of brass. The planes thus formed constituted planes of weakness liable to yield under strain, and thus allowed liquids to penetrate into the mass of the metal. The liquids dissolved out the lead, a portion of the zinc, and a small proportion of tin, and thus brought about the disintegration of the brazing. It was evident that the lead was the injurious element.

Discussion.

Mr. J. T. Milton observed that the defects described in the paper took place more frequently than was imagined. In his opinion it was the brazing metal which was often responsible. He had been assured by manufacturers of brazing metal that it was necessary to use copper absolutely free from antimony or arsenic.

Professor A. K. Huntington referred to an investigation he had carried out on naval brass whereby he found that the brass had become too low in zinc. There were, however, so many loopholes for mistakes in connection with brazing that he looked upon the brazing of copper pipes as a barbarous system which ought to be discarded in favor of other methods, even if they were more costly.

Sir Gerard Muntz said the question was whether the trouble referred to arose from the presence of tin or the presence of lead. From practical experience he was certain that it arose from the tin.

Mr. J. M. Allan stated that he had endeavored to make bronze alloys with pure copper, but he had found that the general result was a reduction in the tensile strength and mechanical properties, and that ordinary copper with a percentage of arsenic was more suitable.

Professor Louis in replying on the discussion contended that the lead in the particular case dealt with by him was equally guilty with the tin. He agreed that the brazing of copper pipes was not a satisfactory practice, and he had pointed out to the Board of Trade that any risk of that nature would be avoided by the use of solid drawn instead of brass steam pipes.

Editor's Note.—Copper pipes are more or less a necessity on board ship because of their requirement to assume bends and shapes not called for in stationary steam plant practice. The bends in a marine layout must be of large radius in terms of the pipe diameter, so as to ensure flexibility due to possible extension or contraction between fixed points, caused by structural movement of the vessel, particularly in heavy weather.

Societies and Personal

Mr. F. A. Yerbury, of the Canadian Boving Co., has returned to Toronto from a two months' trip through the West.

* * *

The Engineers' Club of Toronto, 94 King Street, West, resumed its series of weekly meetings on Thursday evening, October 12th, when Captain K. Gamble delivered the opening address. Mr. Willis Chipman also spoke briefly on club affairs, following which a general discussion took place.

* * *

Mr. H. V. Tyrrell, manager of the MacLean Technical Publications, among which is included The Power House, was married to Miss Jean Young, of Newcastle, Pa., on Tuesday, 10th October. Needless to say, the best wishes of the staff and his many friends among subscribers and advertisers, are extended to him and his good lady for a long, happy and prosperous union.

An industrial commission was looking over a mill. While the investigators were busy the whistle blew. The workmen put up their tools and vanished as if by magic.

"Do all of the workmen drop their tools the moment the whistle blows?" asked one of the commission.

"No, not at all," said the workman who was acting as guide, "the more orderly men have their tools all put away before that time."—The Silent Partner.

The man who uses his fingers to test the possibilities of a dangling piece of insulated wire belongs in the same ward with the idiots who rock boats and point unloaded guns at people.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV OCTOBER, 1911 No. 10

MANUFACTURERS' CATALOGUES.

WITH the resumption of Engineers' Society meetings, and the more regular presence of the members in the Lodge Room, there arises a desire for literature pertaining to the power plant equipment and operation, for reference and study. Manufacturers and their representatives should therefore see that the various branches of the different organizations are supplied with this material. Needless to say, results will be found mutually beneficial.

QUESTION AND ANSWER SERIES.

DURING the last three or four months the "Question and Answer" Department was omitted from the pages of The Power House, partly because of its being the summer or off-study season, and in part with the idea of allowing operating engineers the opportunity of working out answers to a series of questions covering more or less the ground previously traversed. Recently, we have had numerous requests to resume the original series, and presuming that these voice the sentiments of a considerable section of subscribers, we have in this present number reproduced the series of questions appearing in the September issue, together with the answers required. Might we suggest that these monthly sets of "Questions and Answers" be discussed and investigated at the various C.A.S.E. lodge meetings.

READERS' PRACTICAL ARTICLES.

OUR invitation—"Reader, what do you know?"—has met with a ready and hearty response from subscribers in every part of the Dominion, and goes to show the wealth of experience to be found in the work-a-day power plant, which was being more or less lost to the "common good" by its so little esteemed importance. In a word, it was considered hardly worth talking about, and much less writing about. From a perusal of our "Practical Article" pages there will be noted not only a diversity of topics, but also the widely-scattered field or location of the individual writers.

POWER GENERATORS.

IN recent issues, we have dealt at some length with the progress and development of the steam turbine, gas and oil engines, and have spoken of them as formidable rivals to the reciprocating steam engine. That there has been no halt in the process of perfecting these "newcomers," if we might apply the term, is only straight everyday fact and experience. While, it may be urged, the larger part of this "displacement of the old and installation of the new" is as yet confined to marine engineering practice, no callousness to the trend of events there will stop the sure entry of steam turbines and internal combustion engines into the sphere of stationary power plants, large and small.

Reference is made in another part of this issue to great forward steps being taken by the installation in the two new C.P.R. Pacific Ocean liners of steam turbines, involving new features in size and arrangement. Further, there has recently arrived in Montreal, after crossing the Atlantic from the east coast of England, a large vessel for service on our lakes, and whose motive power is none other than a Diesel oil engine. We are prone to believe that this chimneyless vessel is the forerunner of many such, and holding this view, we believe it our duty to bring prominently before manufacturers and operators such information as our position secures concerning the far-reaching changes that are taking place, so that each may "set his house in order."

POWER PLANT CENTRALIZATION.

THAT a growing tendency toward centralization is much in evidence no one associated with power plant work will for a moment question. The rapidity of improvement and development noticeable in recent years has, we are afraid, been such that the great majority of us were not able to keep pace with it. In two features this is true; first, we have not interested ourselves enough to know what others have been doing, and second, as a result of the first, we are not in position to grasp the opportunities which the new and continually-changing order of events is placing before us for acceptance. The demands of each successive day, for increased tangible returns to our efforts, have overshadowed every other consideration, and impatience, breeding worry, has otherwise unfitted us to qualify for the higher positions when offered.

In view of this power plant centralization tendency, it is incumbent on those who operate small plants in factories, etc., to see clearly how they, particularly, stand in relation to it. To us it seems their existence is at stake, unless their ability and efforts are such as either to show they can hold their own under competitive conditions or that they are qualified to step into the more exacting sphere of large central station operation. We frankly admit that in common with other men in most trades and professions, there is neither a superfluity of glory or hard cash assured as the result of well and wisely directed effort, yet we believe that while we owe it to ourselves to get all the honor and gain we can, we further owe it to our age and generation to do some little for the common good, realizing that although we may not always be able to command recognition, we can at least always deserve it.

Power Plant Troubles, Happenings and Improvements

A Critical Review, Affording an Opportunity for Readers to Keep in Touch With What is Being Said and Done by Their Confreres. A Progressive Study of the Light That is Being Thrown on the Elements of Design, Constructional Detail, and Operation of Power Plants; the Troubles Arising Therefrom, the Difficulties to Contend With, and the Remedies Suggested.

ENGINEERING PROGRESS.

THE following information, from an Old Country source, in intimate touch with engineering progress and development, tells in plain unvarnished language the present and future outlook for that trusty henchman, the reciprocating steam engine, with which most of us have grown up and learned to revere to the extent that while men might come and go, it at least would remain, conquering and to conquer. How are the mighty fallen, and what is our stand relative to it?

Although what follows, concerns more directly the marine side of power engineering, it is equally true of stationary plant practice and therefore becomes incumbent on all thus engaged, to so adjust and fit themselves, that the transition may be smooth and continuous under the rapidly approaching and new order of things.

Some Important Departures.

"When shipbuilders—or, to be strictly accurate, shipbuilders who are also marine engineers—turn from the human element in their works to the scientific, they find themselves face to face with problems of even more absorbing interest. It is not necessary to look back more than one year into history in order to justify this statement. The marine steam turbine is one of the commonplaces of engineering, but all its possibilities are not yet known. It was born on the Tyne, but was cradled and nursed on the Clyde. At the present moment more is being done on the Clyde than anywhere else, to show that its sphere of usefulness may be widened far beyond the present limits. Clydebank has proved that the Curtis type, imported from America and given the hall-mark of Clyde design and workmanship, is capable of doing splendid service; and at Fairfield and Dumbarton the Parsons type is being developed in two different directions. On the large liners which are building for the Pacific service of the Canadian Pacific Ry. Co., the Fairfield Co., are to drive four shafts—for the first time on vessels of [illegible] turbines; and on the two railway steamers which the same firm are building for the Havre cross-channel service, as well as on two British destroyers at Dumbarton, the geared turbine is to be used for powers vastly higher than in [illegible]. With at least two other forms of reducing gear past the experimental stage, a 5,000-ton oil-engined vessel making ready at Whiteinch for trials in December, and a number of similar ships building at different continental yards, all threatening to abolish the steam engine as a marine motor—not to speak of the gas-producer ship looming out of the shadows as it were—there is enough to keep the marine engineer who would remain abreast of the times, thinking very hard indeed, even if he had no labor problems to consider at the same time."

COMPARATIVE DUTY TESTS OF PUMPING ENGINES.

TESTS showing the comparative duty of two types of pumping engines were made by Francis Head at the Torresdale filter plant. These units furnish a large portion of the water supply for the city of Philadelphia. There are installed at this plant seven compound engine-driven centrifugal pumps, each having a capacity of 45 million gallons per day against a head of about 45 ft. and one steam turbine-driven centrifugal pump of a capacity of 50 million gallons per day against the same head. During the past year, six of the engine-driven pumps and the turbine-driven pumps were carefully tested for economy, according to the specifications, by representatives of the contractors and of the city. The report gives detailed results of the test, and shows that the turbine-driven pump developed a duty over 21 per cent. in excess of that shown by the compound engine-driven pump.

The economy developed by the turbine pump was 104 million foot pounds per thousand pounds of steam, not crediting the pump with the head lost in the condenser and power consumed by condenser. The table below gives detailed results:

	Turbine.	Engine.
Date of tests	Jan. 13-14,1911.	Oct. 20-21, 1910
Steam pressure at throttle	173.3 lbs.	.....
Steam pressure at boiler	.....	175.5 lbs.
Superheat at throttle	53.2 deg. F.	.....
Vacuum in turbine case	28.8 ins.	.....
Vacuum at wet vacuum pump	.....	26.26 ins.
Revolutions per minute	741.6	177.4
Water pumped, gals. per 24 hours	49,750.000	47,850.000
Total head	44.71 ft.	43.27 ft.
Water horse-power developed	390.09	363.09
Steam used per hour without condenser pumps	7,398.3 lbs.	8,359.8 lbs.
Steam used per hour by condenser pumps	.....	110.5 lbs.
Per cent. of steam used by condenser pumps	.....	2.04
Steam used per hour per water horse-power without condenser pumps	18.96 lbs.	23.18 lbs.
Saving of turbine over engine $= \frac{23.18 - 18.96}{23.18} = 18.2\%$		
Duty, million ft.-lbs.; work done on the water per 1,000 lbs. of steam, not crediting pump with head lost in condenser	104.4	.....
Duty without charging steam used by vacuum pumps	.....	86.0
Duty, assuming two-thirds of vacuum pump steam to be saved by heating feed water	.....	85.4

AIR RECEIVER EXPLOSION.

An enquiry was held recently at Dunfermline (Scotland), before Sheriff Umpherston and a jury, into the facts of the death of David Robertson, who was killed at Bowhill Colliery in consequence of the receiver of a steam-driven air-compressor plant, of which he was in charge, bursting or exploding.

Robert Anstruther Muir, manager, stated that the plant was purchased by himself and the Bowhill Co., about 1899, and it worked satisfactorily. They never, when making examination of the plant, found any indication of defects. The plant was not new when it was bought. The plate of the air-compressor was ⅜ in. thick, and its safe working load would be about 100 lb. He did not think the accident could be due to normal working conditions. There must have been a high temperature inside. It might have been brought from the outside. The theory he had formed as to the accident was an internal ignition. Any oil put in the air cylinder would in the course of time find its way into the receiver and naturally accumulate. It had been his practice all along to use common engine oil for air compressors. It would be quite right to use a safer oil even where they were working at low pressures. He thought the receiver was cleaned out about two years ago.

Neil Anderson Wilkie, manager, Bowhill, stated that he knew that the safety valve was working on the morning of the accident, because he heard the air flow-

ing from it. He had had no trouble with the plant since he went to the colliery eleven months ago, and it was working all right now. He thought there must have been some internal ignition inside the receiver with consequent large increase of pressure and heat. Since the accident, they were using partly common engine oil and partly soapsuds for lubricating purposes. The company would not now continue the arrangement for lubricating purposes employed before the accident.

James Sibbald, engineman, said he had been familiar with the machinery in question for about seven years. There was an outlet cock at the bottom of the reciver, and it was used regularly three times a week. Sometimes a little oil came out of the cock.

David Muir, head engineer at the colliery, said that during his time, there had been no examination of the plant, which had worked quite smoothly. Witness further said that he had wrought air compressors before the Bowhill one, and at these, there was a special compressor oil in use.

Mr. Robinson, H. M. inspector of mines, said that common oil was not the sort of oil to use for compressors generally. He found that it was occasionally used, and in these cases, he drew attention to its low flashpoint.

Mr. Colvin, representing the Scottish Mine-owners' Association, said that under normal conditions the oil in use would have been quite safe, as its ordinary flashpoint was much above the temperature at which the compressor was working.

The jury added to their formal verdict an order that they were of opinion that a special oil should be used in connection with plant of that kind.

The foregoing is a reprint from the "Colliery Guardian" Journal, London, England, and in its detail does not throw much light on the cause of the explosion. Perhaps some of our readers from experiences with air receivers, can throw additional light on the question of oil. It looks to us as though old age was a leading characteristic of this particular receiver, and that irrespective of an oil explosion internally, its condition through rust, etc., had become such that sooner or later it was bound to give out and did so.—Ed.

TESTS OF A. E. G. TURBO-GENERATOR SETS.

The following details cover the official test performances of two A. E. G. turbo-generator sets installed in the Dunston power station of the Newcastle-on-Tyne Electric Supply Co.

The sets tested are rated at 6,500 kw. economical load and 10,000 kw. maximum load, their speed being 1,200 r.p.m. The turbine of the A. E. G. impulse type with a 'uniflow' steam passage is designed for a steam pressure (by gauge) of 190 lbs. per square inch with steam superheated 190 deg. F. The three-phase alternators were designed for a continuous output of 8,000 k.v.a. at 0.9 power factor, the terminal pressure being 5,750 volts at 40 ~ per sec. Direct coupled self excited machines provided the field current. The condenser has a surface of 17,760 square feet, and is of the double pass variety. Each tube has an external diameter of 23 m.m. and a thickness of 1 m.m. An hourly allowance of 450,000 gallons of circulating water was specified as a maximum, at a temperature of 50 deg. F. Three-throw compound air pumps, motor driven, are employed.

Following are the tabulated results of the tests:—

Test Data.

From the information afforded it seems that the circulating water allowance was exceeded by 110,000 gallons per hour, the total amount being 560,000 gallons or 73.7 lbs. of water per lb. of steam.

Intervals of 1.5 hours were allowed between changes of load with the exception of the special trial on No. 2 machine with high superheat; this was commenced after the expiration of an hour. The condensed steam was weighed by the permanent weighing tanks erected in the power house. An energy meter was specially constructed for the purpose and was tested during the trials. All the thermomenters used were calibrated against a standard platinum resistance thermometer and the necessary connections applied; the pressure gauges were also calibrated.

In addition to consumption tests the plant had to meet a number of electrical stipulations, and to ensure that these had been complied with a number of tests were applied. First, there was the orthodox insulation test, in which the stator windings of No. 2 machine stood 12,000 volts a.c. between the windings and frame for five minutes. Then came the short circuit tests; the oil switch being closed on a dead short, and the field opened. In these tests the external resistance of the leads from the machine to the switch was 0.00758 ohm. per phase.

There were five tests in all, as follows:

1. Machine switched on to a 3-phase short at full speed for generating a pressure of 2,000 volts.
2. Same test but with 4,000 volts.
3. Same test but with 5,750 volts.
4. Same test repeated.
5. Machine switched on to a short, across one phase only, when running at full speed and generating full pressure.

Out of these tests the set came with satisfaction.

A 24 hour run was then undertaken with a load of 7,200 kw. at 0.9 power factor, in order to ascertain the alternator's temperature rise. The stator resistance was accurately measured before and after the run, and from the figures obtained it was ascertained that the temperature rise was 27 deg. C. A thermometer situated on the end coils of the stator recorded a rise of 21 deg. C from 11 deg. C. to 32 deg. C.

While the alternator was warm it was subjected to a run of 1.5 hours on 10,000 kw., at about unity factor, and the temperature measured at the end of this run was below the guarantee for overloads.

	Machine No. I.		Machine No. II.			
Number of ½ hour tests	3	1	4	2	2	2
Output from generator to busbars, average true kilowats	6546	6518	6466	3984	7469	6565
Steam pressure at boiler side of turbine stop valve by gauge lbs. per sq. in.	186	184	186	188	182.(5)	185.(5)
Temperature of steam at boiler side of turbine stop valve deg. F.	589	601	579	580.(5)	580	597
Superheat deg. F.	207	220	197	197.(5)	200	215
Exhaust pressure (abs) in. Hg. in condenser	0.76	0.72	0.82(5)	0.62	0.96	0.83
Temperature in condenser deg. F.	69	68	72	64	77	72
Temperature of air pump discharge deg. F.	51	49	56	49	59	54
Temperature of circulating water inlet deg. F.	43	40	43	44	42	43
Temperature of circulating water outlet deg. F.	57	54	57	52	59	57
Steam consumption lbs. water per hour	75.980	74.670	76.832	47.920	95.465	76.425
Lbs. water per kw-hour	11.6(2)	11.4(6)	11.8(9)	12.0(3)	12.1(4)	11.6(4)
Lbs. water per kw-hour corrected for condenser leakage	11.5(7)	11.4(3)	11.8(9)	12.0(2)	12.1(4)	11.6(4)
Steam consumption lbs. per kw-hour corrected for 190 deg. F. superheat and with vacuum as observed	11.7(6)	11.7(7)	11.9(6)	12.1(0)	12.2(6)	11.9(4)

LIQUID MEASUREMENT IN TANK.

By J. H. W., Toronto.

AS requested by G. B. Rexford, Vancouver, in the September issue, we have prepared a table by which the amount of liquid of various depths in a horizontal cylindrical tank may be rapidly figured. The table has been calculated to four places of decimals; but for ordinary purposes it will generally be sufficient to use the first two or three places. It is useless attempting to calculculate the amount of liquid to within five or six gallons—or even more—unless due allowance is made for the space taken up inside the tank by rivet heads, butt-strips, stays, etc. So that, although the table is theoretically accur-

ate, too much reliance should not be placed upon it.

Capacity in Per Cent. of Diameter.

1 per cent. of dia. is .0017 of capacity.
2 per cent. of dia. is .0048 of capacity.
3 per cent. of dia. is .0087 of capacity.
4 per cent. of dia. is 0134 of capacity.
5 per cent. of dia. is .0187 of capacity.
6 per cent. of dia. is .0245 of capacity.
7 per cent. of dia. is .0308 of capacity.
8 per cent. of dia. is .0375 of capacity.
9 per cent. of dia. is .0446 of capacity.
10 per cent. of dia. is .0520 of capacity.
11 per cent. of dia. is .0598 of capacity.
12 per cent. of dia. is .0679 of capacity.
13 per cent. of dia. is .0764 of capacity.
14 per cent. of dia is .0851 of capacity.
15 per cent. of dia. is .0941 of capacity.
16 per cent. of dia. is .1033 of capacity.
17 per cent. of dia. is .1127 of capacity.
18 per cent. of dia. is .1224 of capacity.
19 per cent. of dia. is .1323 of capacity.
20 per cent. of dia. is .1424 of capacity.
21 per cent. of dia. is .1527 of capacity.
22 per cent. of dia. is .1631 of capacity.
23 per cent. of dia is .1737 of capacity.
24 per cent. of dia is .1845 of capacity.
25 per cent. of dia is .1955 of capacity.
26 per cent. of dia is .2066 of capacity.
27 per cent. of dia is .2178 of capacity.
28 per cent. of dia is .2292 of capacity.
29 per cent. of dia is .2407 of capacity.
30 per cent. of dia is .2523 of capacity.
31 per cent.of dia is .2640 of capacity.
32 per cent. of dia is .2758 of capacity.
33 per cent. of dia is .2878 of capacity.
34 per cent. of dia is .2998 of capacity.
35 per cent. of dia is .3119 of capacity.
36 per cent. of dia is .3241 of capacity.
37 per cent. of dia is .3363 of capacity.
38 per cent. of dia is .3487 of capacity.
39 per cent. of dia. is .3611 of capacity.
40 per cent. of dia is .3735 of capacity.
41 per cent. of dia is .3860 of capacity.
42 per cent. of dia is .3986 of capacity.
43 per cent. of dia is .4112 of capacity.
44 per cent. of dia. is .4238 of capacity.
45 per cent. of dia. is .4364 of capacity.
46 per cent. of dia. is .4491 of capacity.
47 per cent. of dia. is .4618 of capacity.
48 per cent. of dia. is .4745 of capacity.
49 per cent. of dia. is .4873 of capacity.
50 per cent. of dia. is .5000 of capacity.

How to Use the Table.

Suppose we have a horizontal cylindrical tank 80 inches in diameter, with a capacity of 5,000 gallons. It is required to find the amount of water in the tank, when the level of the water is 8 inches above bottom of tank.

8 inches equals 10 per cent. of diameter.

Table shows that 10 per cent. of dia. equals .052 of the capacity.

5,000 x .052 equals 260 gallons. Answer.

The values for intermediate percentages may be obtained by interpolation without any serious error. Thus, to obtain the figure corresponding to 18½ per cent., add together the figures given for 18 per cent. and 19 per cent. and divide the result by 2.

It will be seen that the table has been calculated to 50 per cent. only, as the remaining percentages can be easily found by subtracting from the full capacity of tank.

Another Method—Boiler Steam Space.

Draw a circle representing the cross section of the boiler, and above the horizontal centre line draw a line to represent the water level. The small arcs contained between the ends of these two horizontals may be considered as straight lines. Calculate the area of this rectangle by multiplying its mean width by its depth. Add the area thus obtained to half the area of the boiler and subtract the result from the total area of boiler. The remainder will be the area of the cross-section of the steam space, which multiplied by the length will give the capacity. This method is quite accurate enough for all practical purposes, and is recommended in preference to the use of the above table, being quicker. Boilers and tanks are seldom built to the exact diameter and length called for on the drawings, hence the uselessness of trying to calculate their contents too closely.

ELEVATOR PROBLEM.

By O. P. St. John, Toronto.

HERE is a problem which may interest some of "The Power House" readers.

A hydraulic elevator is operated on the "hydro-pneumatic" principle. That is, the pressure required to lift the elevator car is obtained by a volume of compressed air acting on a volume of water contained in an accumulator. We will assume that the capacity of the accumulator is 500 cubic feet, that 400 cubic feet is occupied by water, and the remaining 100 feet by air compressed to a pressure of 100 pounds to the square inch. Also, that the displacement in the water cylinder necessary to lift the car to a height of 100 feet, is 10 cubic feet. When it is desired to lift the car, the admission valve is opened, the pressure of the air in the accumulator forces the water into the water cylinder, filling it and forcing the water piston to the end of its stroke, thus lifting the car to the desired height. The volume of water in the accumulator is reduced by 10 cubic feet, and the volume of air is increased by the same amount, the pressure of the air being correspondingly reduced.

If a ton weight be placed in the car, exactly the same operation is required to lift it to the same height. The same amount of water is admitted to the water cylinder, the volume of water in the accumulator is reduced, and the volume of air increased by the same amount, and the air pressure falls just the same as when the empty car was raised. Expert A argues from this, that the same amount of energy is exerted in lifting the empty car, as in lifting the car with a ton weight in it; while Expert B contends that such an argument is absurd, because the lifting of the ton weight a distance of 100 feet means an additional 200,000 foot-pounds of energy exerted, and that in mechanics as in most other things worth having, "you cannot get something for nothing." Question.—Where is the additional energy exerted? The amount of water, and air used, and the reduction in the air pressure appear to be the same in both cases.

I should like to hear some readers' opinions on the subject.

HYDRAULIC POWER IN CANADA.

In a recent report, Mr. J. B. Challies, hydraulic engineer, Railway Lands branch, gives the following figures as an estimate at the present time of the water power resources of Canada:

	Possible horsepower.	Dev. and in course.
Yukon	470.000	55.000
British Columbia ..	2,065,500	150.100
Alberta	1,144.000	12,000
Saskatchewan	500.000	.....
Manitoba	504.000	160,000 about
Northwest Ter.	600.000	.....
Ontario	4,308,479	350,000
Quebec (exclusive of Ungava)	6,900.000	125.000 about
New Brunswick	150.000	9.080
Nova Scotia	54,300	13,300

Mr. Challies adds that more accurate information is being secured daily of the water powers in the various provinces, but the amount of developed water power is changing so rapidly that it is extremely difficult to arrive at a satisfactory compilation of either the amount developed or undeveloped throughout the Dominion. The only attempt at a complete compilation of our water powers is that of the Commission of Conservation, which has had several engineers for over a year engaged in preparing a detailed, accurate report of both conditions.

The easiest way to find out whether you are right or wrong is to get down to basic principles and work up from them to the question at issue without thinking about preferences, hobbies or personal interests.

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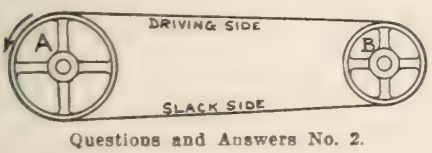
Q—1. In a certain machine the work that should be obtained theoretically is 800 foot-pounds in a given time. The amount actually obtained, however, is found to be only 576 foot-pounds. What is the efficiency of the machine?

A—1. Divide the actual amount of work by the theoretical. Express the result as a decimal fraction. The quotient represents the efficiency of the machine. Thus $\frac{576}{800}=.72$, therefore, the efficiency of the machine is $\frac{72}{100}$, or 72 per cent.

Q—2. What horse-power may be transmitted by a belt 10 inches wide and ½-inch thick running at 42 feet per second; the tension on the slack side being .4 of the tension on the driving side? The stress allowed is 300 pounds per square inch of belt section.

A—2. In the cut, A shows the driving pulley and B the driven pulley. When the belt is first laced on the pulleys there is an equal tension of T pounds in top and bottom part of belt. When pulley A begins to revolve in the direction shown by the arrow, the friction between its surface and the belt tends to carry the latter round with it. The resisting forces on the driven shaft at first prevent the motion of the pulley B, and the friction on this pulley keeps the belt from slipping, the result being that the part of the belt leading on to the



Questions and Answers No. 2.

advancing (top) side of driving pulley A is stretched and increased in tension, while the part of the belt leaving the driving pulley is shortened and has its tension decreased. This increase of tension on the driving side and decrease on the slack side continues, until the difference of their turning effect about the centre of the driving shaft is sufficient to overcome the resisting moment of the machinery, etc.

Let Td=tension of belt on driving side in pounds.

Let Ts=tension of belt on slack side in pounds.

Let V=velocity of belt in feet per minute.

Then the number of foot pounds of work done in one minute is the difference in the two tensions multiplied by the velocity, or (Td—Ts)V. Consequently the horse-power transmitted is

$$\frac{(Td-Ts)V}{33{,}000}$$

We are told that Ts is equal to .4Td; so the expression Td—Ts is equivalent to Td—.4Td, consequently the horse-power formula may be written:

$$\frac{(Td-.4Td)V}{33{,}000}$$

The belt being 10 inches wide by ½-inch thick, its area is 5 square inches, and the allowable stress 1500 pounds, we have:

$$\frac{1500-(.4\times1500)\times42\times60}{33{,}000}=68.72 \text{ h.p.}$$

Q—3. If a man can do 3,000 foot-pounds of work per minute, how many such men would it take to raise an anchor weighing 10,000 pounds from a depth of 30 fathoms in 15 minutes, neglecting weight of chain?

A—3. One fathom is 6 feet, therefore, the anchor has to be raised 6×30, or 180 feet.

The work to be done each minute is

$$\frac{10{,}000\times180}{15} \text{ foot-pounds.}$$

Number of men required is:

$$\frac{10{,}000\times180}{15\times3000}=40 \text{ men.}$$

Q—4. A fire engine hose has a nozzle of 1 square inch cross sectional area, and the water is projected with a velocity of 128 feet per second, to a height of 60 feet. Find the horse-power of engine required to drive the pumps, if the combined efficiency of the engine and pumps is 60 per cent. A cubic foot of water weighs 62½ pounds.

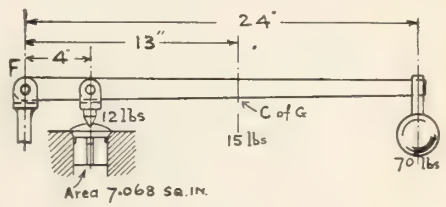
A—4. The quantity of water discharged per second is 128×12=1536 cubic inches. Since there are 1728 cubic inches in 1 cubic foot the number of cubic feet of water discharged per minute is $\frac{1536\times60}{1728}$. Each cubic foot of water weighs 62½ pounds, therefore, the number of pounds discharged per minute is:

$$\frac{1536\times60\times62.5}{1728}$$

This weight of water is raised to a height of 60 feet. Since the efficiency is only 60 per cent., the horse-power required is:

$$\frac{1536\times60\times62.5\times60\times100}{1728\times33{,}000\times60}=10 \text{ h.p.}$$

Q—5. A safety valve is 3 inches in diameter; the lever is 24 inches long and weighs 15 pounds, its centre of gravity being 13 inches from the fulcrum. The weight of the valve and valve stem is 12 pounds, and the centre line of the valve



Questions and Answers No. 5.

is 4 inches from the fulcrum. If a weight of 70 pounds is hung on the end of the lever, at what pressure per square inch will the valve commence to blow off?

A—5. First calculate the area of the valve, thus .7854×3×3=7.068 sq. in. The forces holding the valve down on its seat are three in number:

(1) The weight, 70 lbs., multiplied by its 24 inches distance from the fulcrum, F.

(2) The weight of the lever, 15 lbs., multiplied by the 13 ins. distance of its centre of gravity from the fulcrum.

(3) The weight of valve and stem, 12 lbs., multiplied by their distance, 4 ins., from the fulcrum.

The above three moments act downwards, and their sum must be equal to the upward moment due to the total pressure on the valve, multiplied by its distance, 4 ins., from the fulcrum.

Call the boiler pressure P pounds per square inch. Then

$P\times7.068\times4=(70\times24)+(15\times13)+(12\times4)$

$P\times28.272=1680+195+48=1923,$

$$P=\frac{1923}{28.272}=68 \text{ pounds.}$$

Q—6. A pump delivers 150 imperial gallons of water per minute. What will be the velocity of flow through a 4-inch pipe?

An imperial gallon contains 277.274 cubic inches.

A—6. The area of a 4-inch pipe is .7854×4×4=12.56 square inches.

The pump delivery is 150×277.274=41591.1 cubic inches per minute.

Divide this by area of pipe to get velocity of flow:

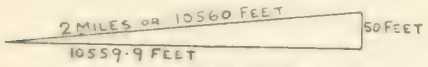
$$\frac{41591.1}{12.56}=3311.31 \text{ inches per minute.}$$

It is usual to express the flow in feet per minute, so we divide the above result by 12 and get for our answer:

$$\frac{3311.31}{12}=275.94\text{—say } 276 \text{ ft. per min.}$$

Q—7. A grade 2 miles long has a vertical rise of 50 feet. What horse-power will be required to haul a load of 120,000 pounds to the top of the grade in 10 minutes, if friction amounts to 5 per cent. of the load?

A—7. The cut shows a diagram of the grade. It will be seen that the horizon-



Questions and Answers No. 7.

tal side of the triangle is (by calculation) 10559.9 feet long. This differs so little from 10560 feet that this latter value may be taken without materially affecting the answer.

The total work done is equal to (a) the work done in moving 120,000 pounds against friction through the horizontal distance of 10560 feet, plus (b) the work done in lifting 120,000 pounds vertically through a height of 50 feet.

Now (a) is equal to 5 per cent. of 120,000 pounds×10560. This equals 6000×10560, or 63,360,000 foot-pounds.

(b) is equal to 120,000×50, or 6,000,000 foot-pounds. So total work done=69,360,000 foot-pounds.

This work is to be done in 10 minutes, so that 6,936,000 foot-pounds of work must be done in 1 minute. Then horse-power required is:

$$\frac{6{,}936{,}000}{33{,}000}=21.01 \text{ h.p.}$$

Q—8. When steam is superheated for the supply of an engine in the usual way its temperature is raised above that in the boiler. Does its pressure also rise? Explain the advantages of superheated steam.

A—8. No, its pressure does not rise. The advantages of using superheated steam may best be explained as follows: Consider the case of an engine using non-superheated steam. On the steam being admitted to the cylinder, part of its heat is immediately used up in warming the comparatively cool walls of the cylinder. This loss of heat, of course, causes a drop in pressure of the steam, accompanied by a certain amount of liquefaction. Then, on cut-off taking place, the pressure begins to fall down to the exhaust pressure, the temperature falling correspondingly. Further liquefaction and cooling of the cylinder naturally result, and the cylinder has to be once more warmed up on the return stroke.

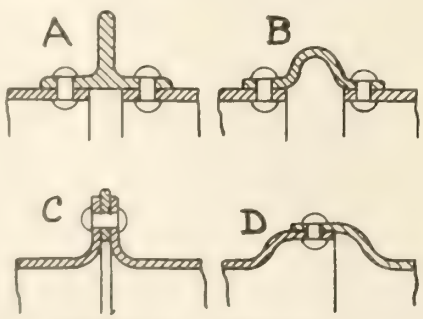
With superheated steam, the temperature of the steam is higher than the temperature corresponding to the pressure. So that the extra heat added to the steam by the superheater is used up in heating the cylinder walls, and the temperature in the cylinder never falls below the "temperature of saturation." Thus a large number of heat units are converted into useful work, which in the non-superheater engine are merely wasted in heating the cylinder.

Q—9. What is the meaning of "wire drawing" applied to steam? What is its effect on the indicator card?

A—9. When steam, through insufficiency of valve opening, contracted ports or throttling, is prevented from following up the piston at full pressure, it is said to be wire-drawn, and its effect on the indicator card is to cause the top line to fall gradually down from the horizontal, showing a reduction in pressure. The corner at cut-off will be rounded and the whole diagram more or less distorted.

Q—10. Sketch and describe some of the methods employed for strengthening the circumferential seams in the flues of horizontal boilers of the Lancashire and Cornish type.

One of the oldest methods is the tee-iron ring shown at A. This gives ample strength and stiffness, but holds the flue too rigidly and does not allow



Questions and Answers No. 10.

of free expansion and contraction. Moreover, the rivet heads are exposed to the direct heat of the furnace and are liable to be burnt.

An improved form of stiffening ring is shown at B. This is known as the Bowling-hoop, and is largely used. It is weldless, and from its form allows the necessary freedom for contraction and expansion; but as with the tee-iron ring, two rows of rivet heads are exposed to the fire.

At C is shown the Adamson's flanged seam, which consists in flanging the flue plates and riveting them together with a ring between. This joint is very elastic and allows of free expansion. The purpose of the ring is to give a calking edge each side. In this joint the rivets are entirely removed from the action of the fire.

D shows yet another type of joint, in which the flues are rolled out to the shape shown and united by a simple lap joint. The strength of the flues is thus greatly increased, and at the same time free expansion is allowed.

Q—11. Why do the driving wheels of a locomotive frequently slip at starting, and how does the application of sand overcome the difficulty?

A—11. If the tractive force exerted by the locomotive exceeds the frictional resistance at the rails due to the adhesion of all the driving wheels, then the wheels will slip. The resistance to slipping varies with the condition of the rails and is greater when they are dry or wet, than when they are merely damp. The application of sand to the rail, of course, increases the friction and enables the driving wheels to obtain a grip. To avoid slipping, the tractive force should not exceed about 22 per cent. of the weight on the coupled wheels.

Q—12. A bucket conveyor driven by an electric motor is used for lifting coal from a railroad car to a hopper 50 feet above the car. If 40,000 pounds of coal are raised per hour, find the horse-power of the motor. Assume the combined efficiency of motor and conveyor to be 60 per cent.

A—12. $\frac{40000\times50}{60}$=foot-lbs. of work done per minute. Since the efficiency of motor, etc., is only 60 per cent., the horse-power required will be

$$\frac{40000\times50\times100}{60\times33000\times60}=16.83 \text{ h.p.}$$

Experiments were recently made by one of the leading Swiss firms as to utilizing the waste heat of exhaust gases from internal combustion motors. In the present case the Sulzer-Diesel motor was used. Water is heated by the exhaust, and the exhaust gases are sent through a set of tubes placed inside a water tank. Air for various purposes can be readily heated, for drying ovens or other purposes. One of the main difficulties was to make the tubes of a suitable material so that the exhaust gases would not attack it. It was found that certain special kinds of cast iron served the purpose.

REFRIGERATION DEPARTMENT

THE ENGINEER AS SUPERINTENDENT.*

By W. H. Beisley.

MY subject covers practically the whole field of ice manufacturing because in many of our smaller plants, the superintendent is virtually plant manager and his duties are very extensive,—the life of the plant in fact. Its very existence depends upon the ability of the superintendent to manufacture the product at a price that can meet competition, or at a price that it can be disposed of at a fair profit to the company. There should be no one better qualified to do this than the practical engineer, acting as superintendent. I shall not attempt to go into all the details that come under the care of the superintendent, but take up those that are more likely to be passed, as not being of great importance, especially in our smaller plants.

Combination Management an Advantage

The engineer, as superintendent, is in a position to master from personal experience, every detail, and should know where to look for many of the small defects that go to make unnecessary expense. It may be that too much labor is employed in the several departments. As superintendent and chief engineer, he is in a position to combine the departments in a manner that will enable him to switch men from one to another; for instance, he could transfer one or more men from the storage room or platform, to assist in the engine room, or fireroom in an emergency, or take some help from these latter (such as ash wheeler or general clean-up man) to assist at the storage or packing departments, to help out a sudden rush. In most plants of fair proportions, there are one or more men in the different departments that must be employed, although part of the time it is hard to find enough for them to do. By having the several departments directly under one management, men can be transferred from one to another without confusion, and without hardship to any one. How many times can you save wages, time, and the delay in securing an extra man, by knowing just where a man can be got, and spared for the time being. I know that one extra man, if properly handled, will usually fill the position, formerly filled by two. In the summer, we usually keep an extra man or two who have no regular line of work, but whose duty it is to do what is necessary, from washing a boiler or sealing a condenser, to driving a wagon.

The Engineer Superintendent at Work.

We will now discuss the practical engineer as superintendent, on his rounds through plant. He will start at the boiler room and go through the entire plant, taking each department in rotation. In the boiler room more money is spent than in other departments, and the chances are, that more is also lost here than in the others, because in the average plant, it receives least attention. Just here, the practical man is very important. He will know at once if there is waste through slovenly or careless firing; if the boiler equipment is at its best, with respect to non-leaking blow-off valve, tight steam joints, tight brick work, furnace conditions, boiler feed pumps and heater. He will see that boilers are blown as often as necessary, that fires are kept at proper thickness, that grates never become uncovered, that coal is fired evenly over the entire grate surface, and that flues are blown and scraped at proper intervals.

Another item requiring attention, is the feed water. This should be passed through a good heater and purifier, and delivered to the boiler as hot, and in as pure condition as a good pump will handle it. I should like to call attention to the fact that too many boilers are over-worked. A crowded boiler is sure to give trouble sooner or later, either by making bad ice or infringing on your coal pile, if nothing worse.

Engine Room Inspection.

Passing to the engine room the several steam traps should be investigated to see that they are performing their functions in proper manner. It may be that they are not working at all, or are perhaps not only allowing water to escape, but steam as well, through a worn-out valve, or stuck float. This is especially liable if the outlet or drain is run into some heater or sewer where it cannot be seen.

Looking next at the gauge board, the first to receive the attention of the practical man, will be the several ammonia gauges that indicate the different pressures. Too much attention cannot be given them. If the condenser gauge shows above normal, the pump for supplying the condenser with water should be examined, for while we want water enough to keep the pressure down to correspond to the temperature of the water, or as near as is practicable, any excess is waste. We should be able to use much less water, if we insist on having the ammonia condensers kept free from scale, and will find that it will more than pay in a season's run, to have a man scrape the coils, if of atmospheric type. If the double-pipe type, cleaning may be done by air, on taking off the top and bottom return bends, or by manipulating the top and bottom three-way valves, found on each coil of nearly all double-pipe condensers. You will be surprised at the amount of sediment you can remove in this way. It will be an advantage to remove all the return bends once or twice in the season, by taking one coil at a time, and brushing out with a good stiff wire brush, similar to what is used for boiler tubes.

Should the condenser pressure still run high, we may try for permanent gases or air in condenser. If these gases are present in large quantities, and especially when there is no excess of liquid ammonia in condenser coils, they will disseminate themselves through the whole system, and interfere with the economical working of the plant. The nearer the condensing and back pressure can be carried together, the more economical will be the working of the plant. It makes no difference how much water you pump through or over the condensers, as it avails nothing until the gases are removed. The condenser, therefore, should get the best of care, in order to reduce the water supply as much as possible.

Engines and Compressor Inspection.

The several engines and compressors. should be in good condition and running smoothly, and it is a good idea to have indicator cards taken from the several steam and ammonia cylinders, periodically. It may be that the steam valves need some slight adjustment, that the

*Reprint from "Ice." of paper read at the Annual Convention of the Southern Ice Exchange, New Orleans, La., March, 1911.

valves in the compressor are not working properly, or the clearance may be too great. Many machines fail to do their work for the want of some slight adjustment that would reduce the clearance to a minimum. I have known several instances where machines fell short from 12 to 15 per cent. on this account alone. Another thing that should be guarded against, is a small charge of ammonia. If you have been running with a small or low charge, increase at once, and see how soon it will cut the coal bill down; and when you have a full charge, try and keep it that way, by watching for any leaks that may occur. Continuous leaks should not be tolerated under any circumstance, being a sure sign of carelessness on the part of some one. If the rods need packing, do it at once, as you will lose more than enough ammonia in a short time to pay for a set of packing. Another important item in the proper working of the plant is the steam condenser. See that the surface is kept free from scale, and that there is a sufficient amount of water to not only condense all the steam sent to it, but to do it with a very heavy back pressure. Do not allow your engineer to hang a weight on the relief valve, in preference to having the condenser properly cleaned.

Skimmers and Reboiler Inspection.

Skimmers and reboilers are most vital parts of the plant in making of good clear ice. The skimmers should be watched closely, to see that they skim only enough to clear the water of any oil that may pass through the oil separators. The reboilers should be kept just hot enough to free the water from any air or other gases that may contaminate it; any more than this is a waste of steam and water as well.

Flat cooler coils should be kept perfectly clean inside as well as out. It is a good idea to steam and flush these once or twice during the season. The flat cooler should have an abundance of good, cool water, direct from the well, and surface enough, so that the distilled water, on leaving the fore cooler for storage tank, will be about the same temperature as the cooling water supplied to the coils. The flat cooler is one of the parts with which you can increase the capacity of the plant; for every unit of heat removed here is that much taken away from the work that the compressor would otherwise have to do. Filters and skimmers, if properly cared for, and doing their work properly, should be good for two seasons without renewing the filtering material. They may be steamed and flushed out once or twice in this time, or oftener, if the experience of the operator deems advisable.

Fore-Cooler and Storage Tank.

The fore-cooler, or storage tank, should be kept full enough to keep the coils always well covered, so that the water will always be in contact with all the cooling surface possible. The nearer you can bring the water in the fore-cooler to the freezing point before going to cans in freezing tank, the more there is gained in the capacity of the tank. It is to the interest of the man in charge, therefore, to see that the distilled water system is kept in the best condition.

It has just been pointed out that the capacity of the plant can be materially affected by an insufficient water supply to flat cooler, and partly submerged coils in fore-cooler. When the ice tanks are in operation, care should be taken to see that the ice is pulled at regular intervals, that is, so many per hour. By doing this, there will not be any trouble in keeping the tanks up to their capacity. You cannot make ice, nor should you expect to, when you have a large number of cans out of tank, for the want of water to fill them, and those that are in the tank only about two-thirds submerged. Above all things be sure that you have a good circulation (brine) in the ice tank. This is of the greatest importance, especially when the tanks are working hard.

Ice Pullers.

The ice pullers should be watched closely when thawing ice from cans, to see that they do not waste too much, especially if the dipping tank is used, or should the sprinkling-dump not have pitch enough to let the ice run out freely when loosened from can. Leaking cans should also be watched and never allowed to be replaced in the tank, until they have been repaired. It costs more to make a bad cake of ice than a good one, as you not only lose the ice, but lose and weaken the brine as well. The brine should be kept at a strength that will not freeze at the temperature desired in tank. Any excess in strength over this is a waste in chloride and time. The brine should be tested from time to time for ammonia leaks in the expansion coils. The tanks should be kept in a clean and orderly manner; all covers and frames should be scrubbed as often as necessary, and kept as dry as possible. Cleanliness around the tank is very essential, as it not only insures your getting good, clear ice, but creates a good impression on visitors to the plant.

Ice Record.

The ice, in passing to the storage or ante-room, should pass through some registering device, so that every cake, or block, sent to these rooms, is automatically registered. This eliminates any chance for a mistake in the amount of ice received from tank room, and may be arranged to count ice passing from ante or storage-room, to the platform or loading dock. It also gives an absolute record of all ice received and sent out. The register we have installed is located in the office, and can be observed at any time.

Ice Storage.

As to storing ice in vaults, our experience is that it keeps in much better condition if clear of floor and walls. This we accomplish by having cribbing, or, in other words, a false floor and walls. The method prevents the ice from hugging the walls, keeps it from the floor, and provides for a circulation down the sides and underneath, by piling the ice a little higher at one side. It not only preserves the ice, but keeps also the walls in good dry condition. The bottom and side layers of ice come out at the end of the season in as good condition as when put in.

A FIRST IMPRESSION.

There is a saying that first impressions are lasting. The first impressions that many a visitor gets in a shop come to him from the reception or waiting room. If he is discerning, what does he think of the up-to-dateness of the concern when he finds before him a table covered with a motley, disordered collection of magazines and periodicals with the uppermost ones months old? If his call is in August, he may pick up at first a paper of December of the year before, or a journal of the preceding February, or a magazine of March. A very little of an ambitious office boy's time would keep the files of regularly received periodicals up to date, with the current number on top. This is a small matter, but one, that properly attended to, promotes an air of general efficiency.—Ex.

Have you thought of the engineer as a mechanic who must know more, work longer hours, carry more responsibility, and have much more expected of him than of any other ordinary mechanic, and still get a smaller sum on pay day?

Editor—"We are sorry to lose your subscription, Mr. Jackson. What's the matter? Don't you like our politics?"

Mistah Jackson.—" 'Taint dat, sah; 'taint dat. Mah wife jes' been and dun landed a job o' wuk foh me by advertisin' in yoh dahned ol' papah."—The Silent Partner.

PRACTICAL ARTICLES BY OUR READERS

Readers are invited to contribute to this Department with Short Articles and Personal Experiences—We pay for all Accepted Material.

SAFETY VALVE RULES.

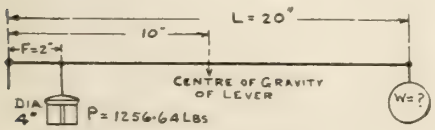
By Charles J. Mason.

CONCERNING the apparent discrepancy between the different rules relating to safety valve calculations, particularly that in Reed's Engineer's Handbook (an English publication used by candidates for British Board of Trade certificates of competency) and those used by the I. C. S., the reader will discover, after carefully reading the following statements, that both rules referred to will give the same results in any given problem when intelligently applied. In other words, both will be found correct, although there is a possibility of misunderstanding them and so obtaining different answers.

If the safety valve problem could be handled without taking into consideration the effective weight of the lever, then it is not likely there would ever be any chance of candidates misunderstanding the matter. The effective weight of the lever must, however, be taken into the calculation if accuracy is desired, and, of course, in such a circumstance, accuracy should be desired. Let us see what the effective weight of a safety valve lever is and what relation it bears to the calculation. In the first place, there is a difference between the effective weight and the effective moment of a lever. Either may be used in the safety valve problem, but it must be clearly understood how and where. Probably, the whole difficulty that candidates have with the safety valve problem lies just in this point. The effective weight of a lever is found by multiplying its weight in pounds by the distance of its centre of gravity from that point called the fulcrum, and dividing the product by the distance that the centre of the valve, upon which the lever acts, is from the fulcrum. The effective moment of a lever is found by multiplying its weight in pounds by the distance of its centre of gravity from the fulcrum. The distances referred to are measured in inches.

I—Calculation Example.

Referring to the following example: Required weight to be placed at the end



of the safety valve lever shown on the diagram, in accordance with the given data.

Diameter of valve, 4 in.
Area of valve, 12.5664 sq. in.
Steam pressure per sq. in., 100 lbs.
Weight of lever, 20 lbs.
Weight of valve and stem, 10 lbs.

Total upward pressure on the valve is 1256.64 lbs.

The letter c represents the sum of the effective moments of the valve and stem, and also the lever. The effective moment of the lever is $10\times20=200$; the effective moment of the valve is $2\times10=20$, and the sum is $200+20=220$.

Now, $\frac{FP-c}{L}$ = weight, or

$$\frac{(2\times1256.64)-220}{20}=114.664 \text{ lbs.},$$

being the weight to place at the end of the lever. This method employs effective moments of valve and lever.

II—Calculation Example.

Let us try the same example by using the I. C. S. rule, which employs the effective weight of the lever, and the actual weight of the valve. The rule is stated thus: "To find the weight which must act on a lever at a given distance from the fulcrum so that the valve is about to blow off at a given pressure, subtract the downward force due to the weight of the valve, stem and lever from the product of the area and the steam pressure. Multiply the remainder by the distance from the fulcrum to the centre line of the valve, and divide this product by the distance from the fulcrum at which the weight is to act." Expressed in a formula it appears like this:

$$W=\frac{(AP-w)D}{L}$$

W=the required weight in pounds.
A=the area of the valve in sq. in.
P=the pressure per sq. in.
D—distance in inches from the fulcrum to the centre line of valve.
L=distance from fulcrum at which the weight is to be placed.
w=the weight of the valve and stem in pounds plus the effective weight of the lever.

lbs.

Weight of valve and stem .....= 10

Effective weight of lever $=\frac{10\times20}{2}=100$

Total downward force due to both valve and lever .....=110

that is, w in the formula=110 lbs.

$$\frac{(12.5664\times100-110)\times2}{20}=114.664 \text{ lbs.}$$

the same answer as obtained by the first method employed.

The effective weight of the lever will be $\frac{20\times10}{2}=100$ lbs.; that is, this lever, because of its weight and its point of contact with the valve, is equivalent to 100 lbs. being placed directly on top of the valve. The effective moment of the same lever will be: $20\times10=200$.

Now, either the effective weight of the lever or the effective moment may be used in the calculation, as has been shown, but each has its own place in the operation, as we shall see a little further on. The equality of moments in the safety valve problem are stated like this:

$$W\times D+W^1\times D^1+w\times d=p\times A\times d$$

In which,
W=weight in pounds;
D=distance in inches that weight is placed from fulcrum;
W^1=weight of lever in pounds;
D^1=distance of centre of gravity of lever from fulcrum.
w=weight of the valve and stem in pounds;
d=distance centre of valve is from fulcrum;
p=pressure in pounds per sq. in.;
A=area of valve in sq. in.

By applying the formula to the problem we see that the answer obtained is correct. Showing the letters, and substituting the numerals of the example, we have:

$$W\times D+W^1\times D^1+w\times d=p\times A\times d,$$
$$114.664\times20+20\times10+10\times2=100\times12.5664\times2,$$
$$2293.28+200+20=2513.28$$
$$2513.28=2513.28$$

Any safety valve rule or formula that can successfully stand the above test is correct and may be safely employed.

Formulae for all Safety Valve Problems

In order to arrive at the point to which we have been aiming, and also to make it as clear as possible, we may state that from the foregoing formula of moments, a series of formulae can be derived that will handle the safety valve problem in all its phases. They are as follows:

(1) $F\times S\div L=W$.
(2) $F\times S\div W=L$.
(3) $L\times W\div S=F$.
(4) $L\times W\div F=S$.

F=the force acting upward against the

valve, this equals the pressure per square inch times the area of the valve, from the product must be subtracted the weight of the valve and stem.

S=the distance from the fulcrum to the centre of the valve.

L=distance from the fulcrum to point where the weight is hung. (This may or may not be at the extreme end of lever).

W=the weight in pounds of the weight to be hung on lever.

In cases (1) and (2) the effective weight of the lever must be subtracted just before multiplication occurs. If effective moment of lever is to be employed, then the effective moment is to be subtracted just before division occurs.

In cases (3) and (4) the effective weight of lever is to be added just before multiplication occurs.

If the effective moment of lever is to be employed, then it will be added just before division occurs in the formula. It is very important that a distinction be made between the two phases of the four cases, and then no trouble will be experienced. Bearing in mind what has just been stated, and being ready to refer to it again, we will now try our problem by using Reed's rule, which is stated thus:

Reed's Rule.

(1) Find the area of the valve and multiply it by the pressure per sq. in.

(2) From the product deduct the weight of the valve (which, of course, includes the stem).

(3) Multiply the remainder by the distance from the fulcrum to the valve, then subtract the moment of the lever, and divide by the distance from the fulcrum to the weight.

In Reed's Engineers' Handbook the effective moment of the lever has the same definition as that which appears in the earlier part of this article.

Using the figures in our example and following Reed's rule, we have: 12.5664 sq. in. (area of valve)×100 (pounds pressure per sq. in.)=(1256.64 lb. total upward pressure)—(10 lb. weight of valve and stem)=1246.64 lb.×(2 inches distance from fulcrum to valve)=2493.28 lb.—(200 moment of lever)=2293.28 lb.÷(20 inches distance fulcrum to weight)=114.664 lb. weight. Ans.

Thus we see that exactly the same answer is obtained as found before. Reed's rule is therefore all right if intelligently used. Now, suppose that we were to use Reed's rule, but instead of having the effective moment of lever [illegible] the effective weight instead. The effective weight of the same [illegible]

$\frac{20\times10}{2}$=100 lb. The operation will be as follows: (12.5664 sq. in. area of valve)×(100 pounds pressure per sq. in.)=(1256.64 lb. total upward pressure against valve)—(10 lb. weight of valve and stem)=(1246.64 lb. balance)—(100 lb. effective weight of lever)=1146.64 lb.×(2 inches distance fulcrum to valve)=2293.28÷(20 inches distance fulcrum to weight)=114.664 lb., which is exactly the same answer as in the other two cases.

Again would we direct attention to the difference between the two latter cases, and particularly the place in each where the subtraction of the lever factor takes place. Suppose the effective weight of the lever were subtracted after multiplication had occurred, instead of before, then we would have the following: 12.5664×100=1256.64—10 = 1246.64×2=2493.28—(100 effective weight of lever)=2393.28÷20=119.664 lb. weight. We have, therefore, 119.664—114.664=5 lb. difference in excess. In other words, by so doing, the valve would be overweighted five pounds. Of course, the percentage of difference is small, but it is further aggravated by the frictional resistances, and it is not on the safe side of the calculation.

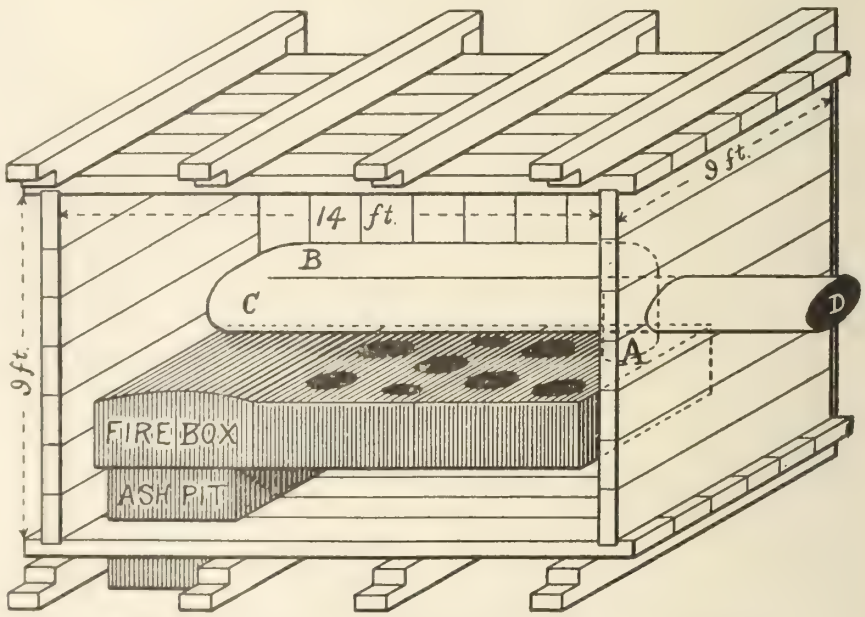
Suppose, on the other hand, the effective moment of the lever were subtracted before multiplication occurs, we would have: 12.5664 × 100 = 1256.64 — 10 = 1246.64—(200 effective moment of lever) =1046.64÷20=104.664 lb. weight.

We have, therefore, 114.664—104.664= 10 lb. difference, below actual requirement. Let the interested reader study this matter out for himself and try the arithmetical operations in the different cases. In this way he cannot but come to a correct and complete understanding of all that is embraced in the problem, as far as an operating engineer is concerned, when standing examination for a certificate.

In conclusion, any rule relating to the safety valve which a candidate is not sure of should be tested by the application of the equality of moments formula before referred to.

WOODEN BOILERS.

CONSEQUENT on the "hazing" of a newspaper reporter by P.D.Q. in our August number, on the subject of wooden boilers, a correspondent has furnished us with a copy of "The Locomotive" magazine, of date October 25th, 1910, issued by the Hartford Steam Boiler Inspection and Insurance Co. Among the contents is an article on "Wooden Boilers," which we reprint as follows, believing the matter to be of sufficient interest to our readers, if for nothing else than to inform them of the crude appliances which marked the early days of steam engineering, and to show the tremendous development that has since taken place.



Wooden Boiler in the Centre Square Water W orks, Philadelphia.

"The following extract, from a recent issue of the New Haven Evening Register, may be of interest to those who were unaware that wood was sometimes used as structural material for the manufacture of boilers, in the early days of steam engineering.

"The newspapers of New London, Conn., have long occupied a prominent place in the opinion of those who seek accurate information respecting marine affairs. This was so, even back in 1817, when the New London Gazette was being

pulled out of the press; for that paper 'explained' the real reason for the accident that 'befell the Norwich steamboat on July 2, 1817,' and the points brought out were so important that the Connecticut Herald of Tuesday, July 15, 1817, reprinted the Gazette's story of the accident, assigning, as its cause, the fact that a wooden boiler was used. Think of a wooden boiler, and figure out where the ocean-skimmers would wind up, if such boilers were used nowadays!

"The Gazette disliked the idea of misleading the public, as do all good newspapers, and herewith is reproduced the true story of the accident to the Norwich boat, which, as shown, was due entirely to the desire of someone to save money:

" 'The account given of the accident which befell the Norwich steamboat on the 2nd instant, and running through the public papers, is calculated to mislead those who are unacquainted with steamboats The facts are as follows:

" 'The boat in question is a small vessel, lately built, and owned by a few individuals in Norwich, to ply between Norwich and New London. The proprietors, wishing to save the expense of Fulton and Livingston's patent right and an expensive engine, have put into her a simple engine upon a new construction, and entirely experimental, with high-pressure cylinders and (extraordinary as it may seem) wooden boilers, without condensers, safety-valves, or balance wheels. As was predicted, her wooden boilers burst, and three persons were hurt, though not dangerously.

" 'It is a fact worthy of notice that the steamboats upon the North river and Long Island sound, constructed upon the Fulton and Livingston plan, have been running ten years without a single person ever being injured; and it is impossible that any serious injury should happen to them, since their safety-valves are calculated to relieve an excess of steam spontaneously.

" 'Editors who think the public ought to be correctly informed upon this subject are requested to publish the above.'

"Great boiler this,—made of wood without balance wheels, condensers, or safety-valve.

"The Connecticut Herald, from which the foregoing presumably truthful account of this accident is taken, is a well-preserved copy, owned by John Lucy, former station master at the Union station, New Haven, Conn. The Herald was published by Steele & Gray, printers, on State Street, New Haven."

We are not quite sure whether the next-to-last paragraph of the foregoing was evolved by the present management of the Register, or by his respected fellow-townsman, the former editor of the Herald, long since gone to his reward. If we did know with certainty, we should try, by United States post or through some efficient spiritualistic medium, to let the responsible individual know that balance wheels and condensers are not regarded as in any way essential to the safety of steam boilers, whether the said boilers be made of steel, or wood, or putty.

Wooden Boilers Used With Early Steam Engines.

"Wooden boilers were used to a limited extent when the steam engine was in its infancy, and when the pressures employed were measured, as we might say, in ounces per square inch, instead of pounds. (The term High Pressure, as employed in the foregoing extract, is not to be interpreted in the modern sense, but merely as indicating a pressure higher than commonly employed in other boilers of the same period). The

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily tasks of the pattern shop, the foundry and core room. It is believed that your methods and devices, while good, may be improved, and thereby made more valuable if you publish them, so that other brains may work on them. We will provide the setting and pay you for the material. When your fellow tradesman puts the superstructure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

Scientific American Supplement of November 4, 1876, gives some highly interesting data respecting a wooden boiler regularly in use for nearly four years, in the pumping station of the Center Square Water Works, Philadelphia, Pa. This boiler began its service on January 21, 1801, and continued up to December 1, 1804.

Wooden Boiler at Waterworks Pumping Station.

"The Center Square boiler had the form of a rectangular chest, and was made of white pine planks, five inches thick. It was nine feet square inside at the ends, and fourteen feet long in the clear. It was braced upon the sides, top, and bottom with oak scantling, ten inches square; the whole being securely bolted together by inch-and-a-quarter iron rods, passing through the planks. Inside of this chest was placed a fire-box 12 feet 6 inches long, 6 feet wide, and 1 foot 10 inches deep, with vertical flues, six of 15 inches diameter and two of 12 inches diameter. Through these flues the water circulated; the fire acting around them and passing up into an oval flue situated just above the fire-box.

"The illustration shows the boiler with one side removed. It was fired at the left-hand end, the fire-doors not being shown. The black elliptical patches represent the flues through which the water circulated. The gases of combustion passed horizontally to the right through the shaded fire-box and combustion chamber, then up into the smoke-flue at A, towards the front end of the boiler along A.B., then back and finally out to the chimney, along C.D.

"The fire-box and the water-flues appear to have been made, at first, entirely of cast-iron. A wrought-iron fire-box was next tried, the water flues still being of cast-iron. This arrangement was found to be unsatisfactory on account of leakage, which was attributed to the unequal expansion and contraction of the two metals. Eventually the water-flues were also made of wrought-iron.

"So far as we can judge from the data at hand the smoke-flue, A B C D, was made of wrought-iron from the start. Thus, under date of July 4, 1800, Thomas Cope says of a similar plant, that the wrought-iron for the flue of the boiler over the fire will be imported from England, in sheets 38 by 32 inches; that made in this country being clumsy stuff of different sizes, of which the largest is 36 by 18 inches, with rough edges, which have to be cut smooth by the purchaser.

Supposed Features and Real Defects.

"The low heat-conducting power of wood was supposed to be of great advantage on the score of economy and the water-flues, running vertically through the fire-box were also supposed to be highly important, for like reasons. As might be expected, great difficulty was experienced in keeping these wooden boilers tight, and the one at the Center Square works was replaced, on December 1, 1804, by a boiler having a cast-iron shell.

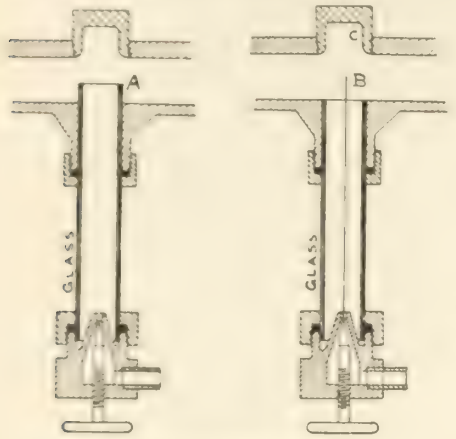
LUBRICATING KINKS.

By James E. Noble.

THERE are a number of schemes adopted by engineers to prevent oil from adhering to the sides of a sight-feed lubricator glass and in time entirely obscuring it. One method of overcoming the trouble is shown at A in the figure. The glass is cut rather long and allowed to project into the

upper chamber. It will be found that oil passes off more readily from a glass cut in this way than when the edge of the glass is low down in the upper chamber of the lubricator.

Another method of accomplishing the same end is shown at B. Here a stiff wire is soldered to the needle point of



Lubricating Kinks.

the valve. The oil follows this wire and escapes from the upper point. Instead of soldering the wire to the needle valve, it may be hung from the inside of the removable plug C. These ideas are not new, probably the first engineers who used them are now under the sod, still they are interesting, and may be new to a younger generation.

INTERNAL COMBUSTION ENGINES.

By A. F. White.

ALTHOUGH more than a score of books have been written upon the internal combustion engine during the last five years, few of them are suitable for the attendant who wishes to become familiar with its operation; therefore, a few practical articles dealing with the above may not come amiss.

In retrospecting internal combustion motor progress for a few years, with special reference to the automobile industry, I feel warranted in saying that it has opened up the greatest commercial epoch the world has ever known. Practically every industry has been touched and given impetus, and no great amount of imagination is required to conceive the future possibilities. Much depends upon the education of the man with the oil can and his attendant with the coal shovel, and it is safe to say that once the broad principles, by which gas is turned into mechanical energy, are properly understood, very little trouble will be experienced.

Internal Combustion Motor, A Type of Heat Engine.

The internal combustion motor is a form of heat engine in which combustion takes place within the cylinder, and the products of combustion act directly on the piston. In this respect, it differs from the steam engine, which may be termed an external combustion motor, because combustion takes place entirely outside the working cylinders, and the heat of combustion is transmitted by conduction through the walls of a containing vessel to a mechanism which does the work.

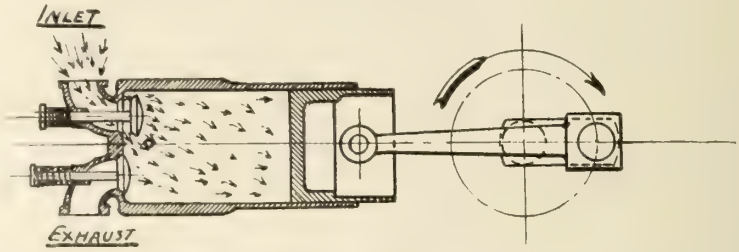


Fig. 1.—Internal Combustion Engines.

Types of Gas Engine.

There are two distinct types of gas engine now used,—the 4-cycle and the 2-cycle. The 4-cycle engine is most common. It was put into practical use by Dr. Otto, on whose account it is frequently called the Otto cycle. Its principle is shown in Figs. 1, 2, 3 and 4. Fig. 1 shows the piston at the end of its first outward stroke, having drawn in a charge of explosive mixture through the inlet valve. Fig. 2 shows the piston at the end of its first inward stroke. The charge is now compressed and at the firing point; consequently, expansion of the gases will drive the piston forward to its second outward position. At Fig. 3, the exhaust valve will have commenced to open and the expanded gases will be expelled by the second inward stroke. Fig. 4 shows the point at which exhaust valve should close and the inlet valve begin to open. This cycle will at once be recognized as that carried out in all 4-cycle engines; so called because 4 strokes of the piston are required to complete it.

The 2-cycle motor, somewhat alike to the 4-cycle, is dependent upon two things for successful operation,—first a charge of gas or vapor must be drawn into the combustion chamber, and, second, this must be compressed and fired at the proper time,—when the piston holds a certain position in the cylinder. The great difference between the two types lies in the fact that the operation is performed by two strokes instead of four, thereby giving a power stroke at each revolution of the crankshaft instead of every other revolution as in the 4-cycle engine.

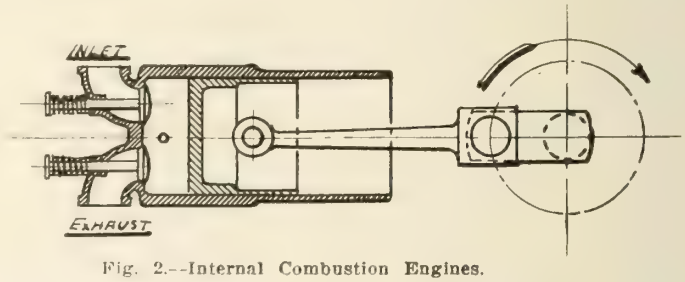


Fig. 2.—Internal Combustion Engines.

The Two Cycle Engine.

The 2-cycle engine must have an enclosed crank case fitted with a valve or a separate charging cylinder as used in the larger sizes. Figs. 5 and 6 show two sectional views of the principal parts of a 2-cycle motor. A represents the ignition plug; B shows a projection on the piston to prevent the incoming charges passing directly across the piston and out at the exhaust port, and C represents the inlet passage from the crank case to the cylinder when the pis-

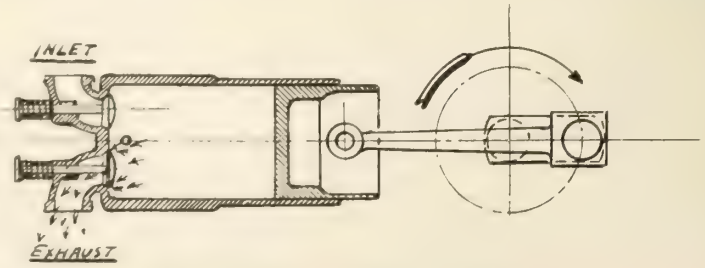


Fig. 3.—Internal Combustion Engines.

ton is at its extreme outer position. In Fig. 5 the ports are both uncovered, allowing the burnt gases to escape at the exhaust port D, while the compressed gas from the crank case passes through the inlet port C, and directs its course upward to the end of the cylinder. Assuming the engine to be in motion and the piston traveling inward, the new

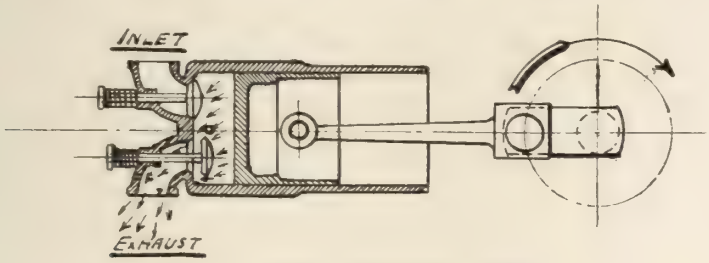


Fig. 4.—Internal Combustion Engines.

charge has now been admitted, and the ports covered; the suction of the piston will open the inlet valve E, allowing a new charge of gas to be drawn into the crank case to replace the one just been admitted to the cylinder. Fig. 6 represents the ignition period. The piston will now be driven on its outward travel, at which time the gas drawn into the crank case is compressed and at at the end of the outward stroke the cycle is again repeated, hence the name "two-cycle motor."

Gas, Gasoline, Coal Oil Engines.

There is no essential difference between engines using gas and those using gasoline or coal oil; the cycle of operations occurring in the cylinder being the same with each kind of fuel, and the only changes being slight structural differences, with the addition of special apparatus for vaporizing the oil. The engines can be and often are converted from gas to oil by a slight change of equipment. The explosive mixture in the cylinder consists of air mixed with a comparatively small volume of gaseous or liquid fuel. The fuels most commonly used are very variable in origin, composition and heat value, and are known as city gas, producer gas, natural gas, gasoline, kerosene and crude oil.

ENGINE CYLINDER EXPLOSION.

By Alfred T. Barnett, Victoria, B.C.

ON July 30, the Taylor mill was burned out with the exception of its office and warerooms. The two cuts accompanying this article will serve to give readers of The Power House an interesting illustration of the fire effects on the saw mill engine.

Fig. 2.—Engine Cylinder Explosion.

Fig. 1 shows the cylinder head to have been knocked off, and the bolts to have been broken just outside the head. The piston, of hollow type was found lying on the ground close to the engine bed, with only the hub part remaining and still attached to the piston rod. The rim piece with the rings intact, I picked up and placed on top of cylinder so that it could be more clearly seen. Fig. 2 shows the engine off the forward centre, ready to start on the return stroke, with all the drip cocks open, and gives one the idea that it died, girded for duty, when the fire started at 2 a.m.,

Fig. 1.—Engine Cylinder Explosion.

Sunday. The flywheel also formed part of the wreckage.

Query.—What caused the explosion in the cylinder of the engine? My opinion is that water found its way inside the piston by means of sand holes or pores in the casting, and these being too small to allow steam to escape when generated by the terrific heat, the natural result was of course an explosion. Fig. 2 shows also the two engines which operated the factory; they, too, having suffered to the extent of bent rods, etc. The engine which suffered by fire and explosion was a 14 inches diameter by 16 inches stroke unit, as far as I could judge without actual measurement

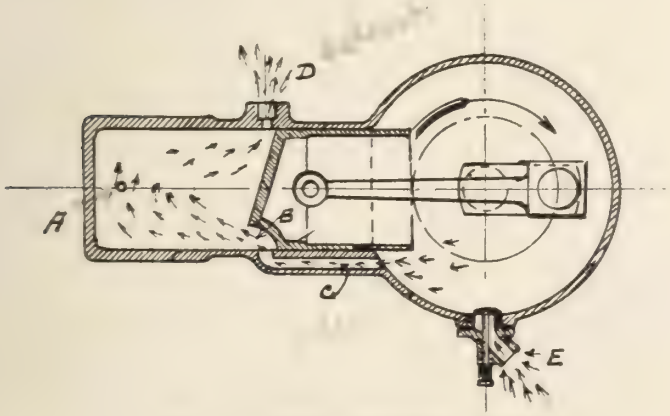


Fig. 5.—Internal Combustion Engines.

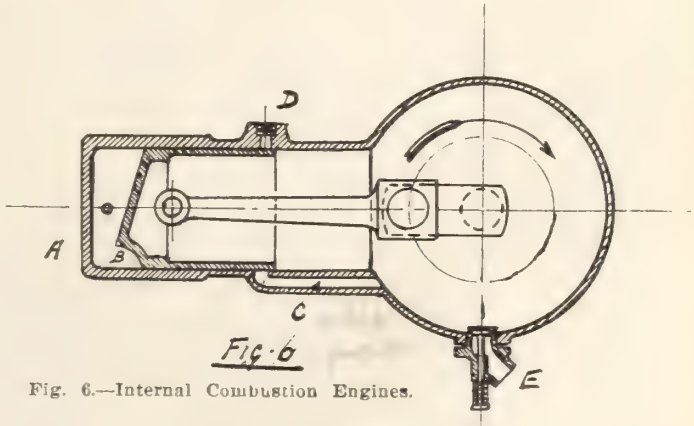


Fig. 6.—Internal Combustion Engines.

CLEANING OUT A SIGHT FEED LUBRICATOR.

By Ernest Ivie, Edmonton.

TO clean the passages and glass of a sight feed lubricator, allow all oil to feed out and afterwards allow a

small quantity of the condensed water to get away. Take off the filter cap and fill up with coal oil and soap well mixed together. Replace the cap and allow the mixture to feed through in manner similar to feeding cylinder oil.

QUESTION OF VACUUM AND FREEZING POINT.

By Ernest Ivie.

THE question is,—"will a vacuum raise freezing point on the fah. scale?"—the following incident being the reason for my query.

Due to the doors being open, the engine room was particularly cold, although not sufficiently so to freeze standing water. While this condition existed, I noticed that the ½-inch pipe connecting the exhaust of a pump with the condensor, had a covering of white frost for a distance of six inches next to the pump. The vacuum gauge stood at 25½ inches, and as already stated, cold water, standing in a bucket close by, did not freeze.

Similar experiences of operators are invited, together with explanation of the phenomenon.

PACKING A DEEP STUFFING BOX.

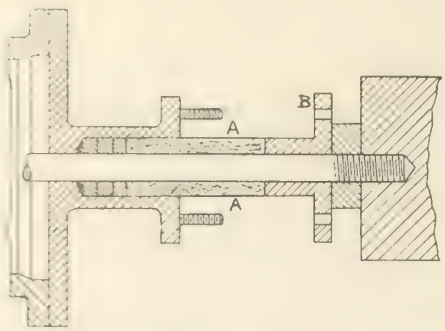
By N. E. J., Toronto.

It is sometimes difficult to force packing to the bottom of a deep stuffing box. A plan often adopted is to put in several rings and tighten down the nuts on the packing gland as far as they will go; then take them off again and put in a ring more and repeat the operation until the box is full. This process is all right, but mighty slow. A method of forcing in the packing often used by engineers is shown in the figure. Several rings of packing are inserted by hand; four pieces of wood, A (the thickness being such that they will just fit nicely into the stuffing box), are placed around the rod, and held in place by an assistant or an old bushing from a wood pulley, if it be something near to a close fit will be O.K. instead of the four pieces of wood. The engine is next turned over slowly by hand until the locknut on the crosshead comes against the gland B, and forces the packing to the bottom of the box as shown. The engine is turned back, more rings added, and the first operation repeated. This method is much quicker than that first mentioned, and only common sense must be exercised and care taken that the packing is not squeezed in too tight.

WATER HAMMER.

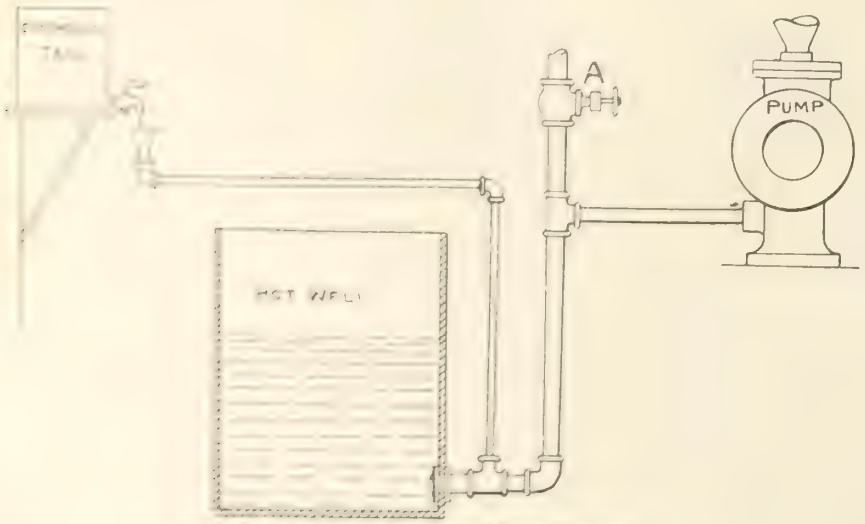
By a Reader, Vancouver.

On the main steam pipe line between a boiler and engine with which I am more or less familiar, there is only one drain pipe and valve. The latter, when closed tight, of course permits considerable water of condensation to accumulate in the piping, and more especially is this the case on each Monday morning, due to the engine being shut down over the weekend. On opening the valve, violent water hammer usually takes place and I want to know if drawing off the water slowly or quickly would help matters. Further, I would like to know if leaving the main throttle valve open or shut would have a favorable effect.



Packing a Deep Stuffing Box.

We believe many of our subscribers can advise our correspondent as to how to lessen the water hammer difficulties he is up against.—Editor.



Compound Feeder for Steam Boilers.

BOILER COMPOUND FEEDER.

By E. J. N., Toronto.

A boiler compound feeder set up by a friend of mine some years ago, and illustrated in the accompanying sketch, had for its aim the attainment of more satisfactory results, because of its sight feed and continuous operation facilities. The idea is so clearly explained in the figure that little further text description is necessary.

The hot well receives all drips from kiln coils, etc., and should the water become too hot for the pump to handle, the valve A, connected to a cold water supply, is opened just enough to lower the temperature in the suction pipe to the right degree. The tap on the compound tank may be adjusted to supply a fast or slow drop, or a steady stream. The apparatus cannot fail to work efficiently, whether the compound does so or not.

AIR COMPRESSOR INDICATOR CARDS.

By Gustave Ahns, South Porcupine.

How should I proceed to take indicator cards from an air compressor? The steam cylinder is 14 inches diameter by 16 inches stroke, the steam pressure 100 pounds per square inch, the air pressure 75 pounds per square inch, and the revolutions 100 per minute.

I. B. S. E. NEWS.

President Healy, of the International Brotherhood of Stationary Engineers, was in Toronto recently, with the object of helping the local men to strengthen their organization. He addressed the local union at the Labor Temple and urged them to admit oilers into their ranks.

C. A. S. E. NEWS.

London, No. 30, C. A. S. E., is in a very flourishing condition; and, as briefly announced in our last issue, has initiated an educational campaign which promises to be highly successful. A committee of five provides 10 questions of a strictly practical nature for each meeting, which are read out by the Chairman. Every member in turn gives what he considers the correct answer, and the best solution to each of the questions is afterwards entered in the lodge minute book. The questions are graded progressively; thus, the first evening was devoted to the duties of a fireman.

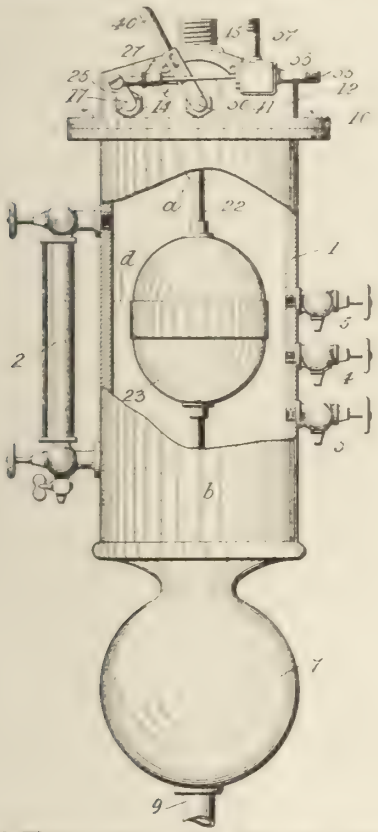
This lodge has over 60 members, and under the presidency of S. E. Cosford, means to make things hum this winter.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

FEED WATER ~~HEATER~~.

THIS device for maintaining a constant water level in steam boilers is being placed on the market by the Heat and Pressure Control Co., 603 Kent Building, Toronto. Its essential features consist of a float and ball valve controlling a supply of compressed air to the top of an elastic hollow diaphragm, which in turn controls the supply of steam to the feed pump. The cut shows the general arrangement of the apparatus, which is coupled to the



Feed Water Heater.—The Heat and Pressure Control Co.

steam and water space of the boiler, and fitted with gauge glass and try cocks. Pipe 35 is coupled to a small air pump or other low pressure air supply, and its open end in box 33 is controlled by a small ball valve operated by spindle 30. By means of a bell crank, of which one arm only (25) is shown in the cut, the float is connected to the handle 40, and also to the adjustable rod 30. When the water is standing at its normal level, pipes 35 and 37 are in communication with each other, and the air flows through 37 to the top of the hollow diaphragm (not shown), compressing it and cutting off the steam supply to the feed pump. Immediately the water level sinks, the falling float and bell crank cause rod 30 to move to the right, thus pushing the ball valve over and closing the end of pipe 35. The air in pipe 37 then escapes through the hole by which rod 30 enters box 33, and the hollow diaphragm consequently resumes its original form, admitting steam to the pump.

It will be seen from the foregoing, that when the water in the boiler is at its proper level, the pump stands idle; but a slight fall from that level at once shuts off the air from the diaphragm and starts it up.

Handle 40 enables float, and consequently water level, to be adjusted to any desired height, the adjustable rod 30 being lengthened or shortened to suit.

AUTOMATIC PISTON ROD PACKING.

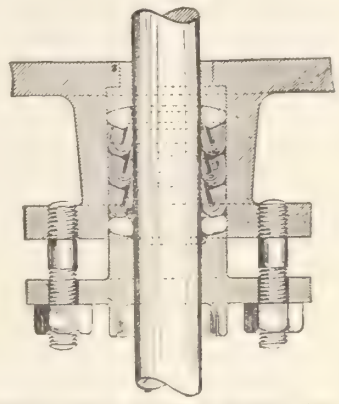
STEAM economizers, condensing plants, the more perfect combustion of fuel in furnaces, and the compounding of engines, with many other vital questions in modern manufacturing industries, have received careful attention at the hands of experts, each in their particular sphere. Until late years, however, little or nothing has been attempted in an effort to obviate the waste of power resulting from the packing of a gland or stuffing box, and practically no change has taken place in the form or style of gland and stuffing box since they were introduced. The amount of power consumed, and the waste energy expended by means of placing so-called "soft" packings in the stuffing box to prevent leakage, whether of steam or liquid, is in some cases so great, more especially in the smaller machines, that there is a large percentage of the total energy necessary to drive the engine, consumed in overcoming friction at that point. This is an item of considerable import, even in the case of the most powerful machines, as every ounce of steam entering an engine means coal consumed which should produce a corresponding amount of effective work.

Automatic Piston Packing, J-M. Sea Rings.

J. M. Sea Rings.

J. M. Sea Rings are molded of a laminated material (asbestos, flax or duck) in the form of wedge, with its thin end turned inwards. There is a hollow space in every ring, between the lip and the heel of the ring, into which the steam follows, so that the steam itself, not the gland pressure, makes the packing pressure tight.

There are two classes of pressure in every working gland or stuffing-box (there must be): one is the tendency of the liquid pressure to leak out to the atmosphere in direct proportion to the extent of that pressure, and the other the necessary holding and tightening of the substance put in the stuffing-box to prevent leakage, that is to say, the screw pressure or gland pressure on the packing itself. With J. M. Sea Rings these two pressures are separated, the fluid



Automatic Piston Packing Stuffing Box with J-M. Sea Rings.

pressure getting behind the long taper tongues and pushing them onto the rod; the outer wall or periphery, taking the whole screw pressure or physical pressure and the long taper tongues acting exactly as the points on a railway line, shunting the fluid pressure back and afterwards on to the rod.

These two mechanical principles are developed and work without complicated wedges, glands, springs, or other artificial aids and means, and stand 600 degrees Fah. superheat perfectly. J. M. Sea Rings are adapted to both horizontal rods and vertical rods, and are suitable for steam-hammers, air compressors, pumps, etc.

The H. W. Johns-Manville Co., through their various branches in Canada, are introducing this packing to steam engineers and others interested.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

BRITISH COLUMBIA.

Armstrong.—Armstrong will equip a complete new waterworks system.

Fort Stanley.—Fort Stanley will equip a hydro-electric station.

Hazelton.—The Hazelton Water, Light and Power Company will equip a new plant.

Adams River.—In connection with the probable ultimate electrification of a portion of its line in the mountains, the C.P.R. has acquired a water-power on the Adams River, near the west end of Shuswap Lake, B.C.

Vancouver.—By the early part of December the Western Canada Power Company will be delivering power in Vancouver from its hydro-electric plant at Stave River Falls, forty-five miles from this city. Announcement to this effect was made recently.

The installation of the generating machinery in the company's power house is now proceeding, and the intake dam is practically completed. The ultimate capacity of this plant will be 50,000 horsepower, and this can be duplicated by the erection of another plant a few miles nearer the mouth of the Stave River than the present one.

Vancouver.—The Western Canada Power Co. has bought a site for its Vancouver sub-station, and will immediately commence the erection of a building which is to be finished and equipped in time to receive power from the company's hydro-electric plant at Stave Falls by the latter part of next month. The property purchased lies on the south side of Powell street, almost opposite the eastern limits of the British Columbia Sugar Refinery yards. In addition to the receiving station for power, the company will also erect on the property a warehouse for supplies. The site extends from Powell street to Albert street.

Vancouver.—The E. H. Heaps & Co., Ltd., are planning the erection of modern machine shops for the building of engines, taxicabs, motor cars and trucks. The company also plan to erect a new mill, a duplicate of the present one at Victoria Drive and Powell St. Capacity of 30,000,000 ft. annually.

Victoria.—Tenders will be received until October 27th, 1911, for the following: Gate valves, pig lead, lead pipe, galvanized pipe, brass goods, galvanized fittings. Specifications can be seen at the office of Wm. W. Northcott, Purchasing Agent, City Hall, Victoria.

ALBERTA.

Calgary.—City machine shop. Architect, City engineer; 2 storeys, 41 x 143, brick and mill construction, concrete foundation, steam heating, electric lighting, tar and gravel roofing. Motors, lathes, electric lighting, tar and gravel roofing, suitable for machine shop are required.

The Independent Order of Oddfellows will erect a business building to cost $100,000. Architect, D. S. McIlroy, 118a 8th avenue W., Calgary; 4 storeys, 110 x 70, reinforced concrete, concrete foundation, steam heating, electric lighting, tar and gravel roofing, elevators, boilers, fire escapes and vaults.

Geo. Colgrove is organizing a company to develop a stone quarry about 150 miles west of Calgary. Equipment to be installed—two derricks, derrick engine, tracks and quarry equipment.

Lethbridge.—Bids will be received until Nov. 24 by G. W. Robinson, Secretary-Treasurer, Lethbridge, Alta., for supplying, delivering and erecting the following equipment for the Power Station Extension: Sec. B—Boilers and accessories. Sec. C—Mechanical draft and economizer. Sec. D—Steam turbo-generator set and condensing equipment. Sec. E—Steam engine driven by exhaust from C generating equipment. Plans and specifications can be obtained from Arthur Reid, Superintendent Engineer, City of Lethbridge.

Innisfail.—By a majority of seven over the necessary two-thirds vote, the ratepayers of Innisfail decided to expend $15,000 on the installation of an up-to-date electric lighting and power plant.

Ada.—The town has closed an agreement with the Canadian Westinghouse Co. for the installation of a complete plant capable of developing 1,500 horse. The work includes poles, wiring and electric service. Cost, about $15,000.

Medicine Hat.—The new electric plant was opened in operation early in September.

SASKATCHEWAN.

[illegible].—Work is in progress for power [illegible] Fraser Street.

Railway Company. President, M. E. Evans, Edmonton. Soundings are being made in the Saskatoon river for a dam site; dam to be built this winter. Power house, car barns, etc., will be started in the spring. The rails will be laid next year.

Regina.—The citizens of Regina, on Oct. 3 voted by-laws to the amount of $897,000 for improvements, included in which was one for $150,000 for trunk sewer and one for $150,000 for a waterworks.

Scott.—The following contracts have been awarded. Tender A—Supply and delivery of generator, exciter, switchboard; transformers and meters; series tungsten street lighting system and pumping machinery, The Canadian Westinghouse Co., Toronto, Ont. Tender B—Supply and delivery of two pneumatic storage tanks, The Polson Iron Works, Toronto, Ont. Tender C—Supply and delivery of approximately 2,200 ft. of 8-in. steel water pipe; approximately 7,000 ft. of 6-in. steel water pipe; approximately 5,400 ft. of 4-in. steel water pipe; approximately 15 hydrants and 22 valves, The Drummond McCall Co., Montreal, Que. Tender D—Trenching and laying steel water pipe, setting hydrants, valves, etc., and back fitting, The Dauphin Sanitary Engineering Co., Dauphin, Man. Tender E—Erection of a power house and construction of a reservoir, Gowe & Yeo, Scott, Sask. Furnishing Diesel oil engine, The Canadian Boving Co. Line material, The Northern Electric Co. Erecting pole line, Fletcher & McGarvey. Wire, Eugene Phillips Co., Montreal.

Davidson.—The by-law has been carried by a substantial majority to raise $10,000 for the purchase and installation of an electric light system.

Regina.—The Estevan Gas, Oil, Heat, Light & Power Co., Ltd., has been incorporated. Capital, $20,000. Head office, Estevan.

MANITOBA.

Winnipeg.—Bissett & Louckes, Ltd., Winnipeg, have been awarded the contract of supplying the Domestic Waterworks System with valves, and T. McAvity & Sons, St. John, N.B., will supply the hydrants.

Winnipeg.—Cotter Bros., Ltd., Winnipeg, have the contract for the supplying of material and erection of an oil and water system, in the city sub-station, at a cost of $1,966.

ONTARIO.

Ottawa.—Tenders will be received at the office of the Commissioners of the Transcontinental Railway, until November 8th, 1911, for the construction and erection complete, in accordance with plans and specifications of the Commissioners, of boilers and boiler-room equipment to be installed in the engine houses. Plans, etc., may be obtained at the office of W. J. Press, Mechanical Engineer, Ottawa.

Ridgetown.—The contract for the new steel tank for the waterworks has been let to the Dubuque Iron Company, of Pittsburg, Pa., at $3,748. It will be 123 feet high, and have a capacity of 55,000 gallons, wine measure. The total weight of the tank when filled, and structure, will be 287½ tons.

Chelsea Green.—The municipality have decided to take hydro power and will instal full equipment. 24 street lights will be put up. Electric equipment for houses will be required. Engineer, H. J. Glaubitz, London.

New Hamburg.—One of the large lager boilers of the Rau Brewing Co., New Hamburg, burst recently and was completely ruined. A new boiler will be installed.

Hamilton.—The Oliver Chilled Plow Works, Hillyard street, Hamilton, require machinery, lathes, derricks, belts and forges, for their new works. Cost $5,000.

Niagara Falls.—Machinery is required for a factory for Watson Gun Sight Co., Niagara Falls, Ont.; 1 storey, 25 x 55, concrete block. Motor, shafting, fine metal working.

Norwich.—The ratepayers of the village of Norwich passed a by-law by a majority of 66 on Sept. 15th to raise $8,000 for the purpose of buying out Mr. H. Webster's outside electric lighting equipment and goodwill, with the intention of running a municipal electric lighting and power business, and buying Niagara power from the Hydro-Electric Commission of Ontario. About half the sum raised will be paid for that part of the old plant that can be used, and the balance will be spent in remodelling it for Hydro power.

London.—The Victoria Hospital, London, has awarded the Canadian General Electric Co. a contract for a complete switch board equipment including lightning arresters, receiving board from the transformers at 13,000 volts, and the necessary distributing panels for both motor and lighting circuits. The contract also includes one single-phase Mather & Platt turbine pump direct-connected to a 20-horse power motor for water supply; a single-stage Mather & Platt turbine pump direct-connected to a 7½ horse-power motor for sewage disposal, and the following list of induction motors: Two 2 horse-power, two 3 horse-power, three 5 horse-power, five 7½ horse-power, one 8 horse-power, three 10 horse-power, and two 15 horse-power. These motors are all intended for operation by hydro-electric current supplied to the hospital at 550 volts.

Sarnia.—The Sarnia Gas and Electric Company have awarded contracts for the renewal of their electric light plant. The electric generators will be supplied by the Swedish General Electric Co., through their Canadian agents, Kilmer, Pullen & Burnham, Toronto. These will consist of one 500 kv. a. unit which will be direct-connected to a Goldie & McCulloch turbine; one 375 kv. a., 100 r.p.m. engine type machine, and one 187½ kv.a., 450 r.p.m. belted type unit. All generators are 60 cycle, 3 phase, 2,200 volt. Three exciter sets will be supplied by the Canadian Westinghouse, and the switchboard by the Canadian General Electric Co. Pumps will be supplied by the Dean Steam Pump Co., Holyoke, Mass. These extensions have been rendered necessary by increased demand for light and power. The apparatus will be installed and in operation by about January 1.

Galt.—Galt will extend its waterworks plant.

Guelph.—Guelph will extend its electric-lighting plant.

Berlin.—Berlin will spend $20,000 on new electric-lighting machinery.

Port Hope.—Port Hope will install a new waterworks system.

Ottawa.—Victoria Island, close to the Chats Falls, on the Ottawa river, thirty miles up from Ottawa, has been sold to the Hon. William Harty. The falls are situated immediately above Fitzroy Harbor, and extend from island to island across the river. The City of Ottawa has had an eye on this power, but the Harty control was found to be complete. Victoria Island has been looked upon as a key to the power situation.

Niagara Falls.—The Niagara Ice Company, Niagara Falls, will install a complete new cold storage and ice-making machinery.

Wiarton.—The Sauble Falls Light and Power Co. intend to establish a steam plant in Wiarton, from which they will develop electricity to give a 24 hours service. They will supply factories or any institution that wants power. This new plant will be operated in conjunction with the plant at the Sauble, and it is hoped to have it in operation within two months. The low water at the Sauble this year has made this absolutely necessary.

Peterboro'.—The Seymour Power Co. have purchased the plant of the Port Hope Electric Light & Power Co., and recently took possession. M. Thos. Tuer has been appointed local manager of the new company and the staff formerly employed by Dr. Corbett will be retained by the company.

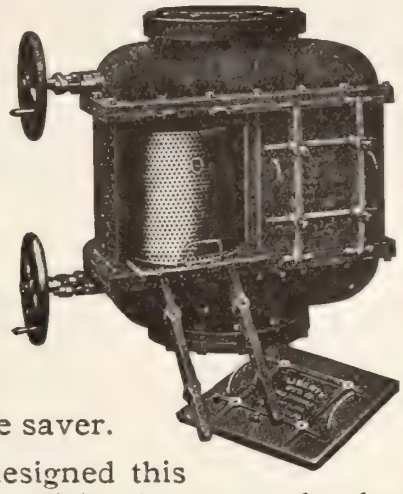
Thamesford.—Two by-laws were passed by the ratepayers, one to purchase power from the Hydro-Electric Commission and another to raise $6,000 to provide for a local plant and its appliances.

North Toronto.—In spite of the fact that the tenders of both the Toronto Electric Light Co. and the Interurban Electric Light Co. appear to have been considerably lower, the contract for the supply of electric energy was awarded to the Toronto Hydro-Electric Department. The price is $2.14 per horse power per month with discount under certain conditions. Mr. E. A. James, the town engineer, proposes light rates the same as recently published for the city of Toronto, with power rates slightly in advance of Toronto power rates.

London.—Contracts for electrical equipment for coal chutes, heating and lighting for station, stores and oil houses are to be let shortly by the Canadian Pacific Railway.

Lindsay.—A by-law will be submitted Oct. 12th authorizing the issue of debentures to be used to purchase the plant, franchises, rights, and goodwill of the Light, Heat and Power Co., of Lindsay.

The "TWIN" Feed Water STRAINER is an Outcome of Necessity.



The up-to-date plant is not complete without this trouble saver.

We have made a careful study of all feed waters, and designed this strainer for the protection of valves and injectors from sticks, leaves, and other extraneous matter.

Either side of the "TWIN" Strainer can be easily cleaned separately, giving an uninterrupted flow of water.

Write for particulars and testimonials

Elliott Company 6902 Susquehanna Street **Pittsburg, Pa.**

Eliminate Trouble and Expense Caused Through Scaly Boilers By Installing a Liberty Tube Cleaner

Mr. Engineer! Scaly boilers mean an unnecessary consumption of fuel and reduced boiler efficiency.

Don't allow this waste to go on when at very little cost you can remove every particle of scale.

The "LIBERTY" Tube Cleaner is efficient and positive in its action, and its small operation cost makes it the most economical cleaner ever produced.

Interesting catalog yours on request
Write for it.

LIBERTY MFG. CO.

6902 Susquehanna Street, - - PITTSBURG, PA.

QUEBEC.

St. Johns.—A by-law will be granted the Canadian Dairy Supply Co., 592 St. Paul St., Montreal, by the town of St Johns, Que., and they move next week. Additional machinery will be required for the manufacture of dairy supplies and cream separators. Steam power to operate plant. Machinery required.

Wm. B. Holyoke Steam Boiler Works of Holyoke, Mass., intend to establish a large Canadian branch. Steam power will be used in the new plant.

St. Lambert.—Montreal and Southern Countries Railway are planning to erect concrete and brick car barns at St. Lambert, and new electric power sub-stations at Chambly and St. Lambert. Plans have not yet been completed. The St. Lambert-Waterloo section of the Central Vermont Railway (which is controlled by the Grand Trunk) will be transformed from a steam to an electric road and operated by the Montreal & Southern Countries Railway. Electric locomotives will be required for freight purposes and large type motor cars and trailers for passenger traffic.

Montreal.—The following bids were submitted to the Board of Control, Montreal, October 3 for the pre-filter of the filtration plant:—F. H. McGuigan, Toronto, Ont., $485,-000; Hanna, Gaultier & Robertson, $554,000, and Laurin & Leach, $584,500.

Murray Bay.—The Eastern Canada Power Company will equip a new power house at Savens Falls, near Murray Bay, Quebec.

NOVA SCOTIA.

Halifax.—It is reported that the Nova Scotia Power Company, in which Mr. E. A. Robert, president of the Montreal Street Railway, etc., is interested, will commence construction work almost immediately on a power development on the Gaspereau River. It is also said that the power so generated will be used in part, in connection with the manufacture of pulp and paper at some point along the Gaspereau river.

THE EEL RIVER POWER CO.

The announcement in The Gleaner that the Provincial Government has arranged to have an expert prepare a report on the available water power for development at the Meductic Falls on the St. John river about forty miles above Fredericton, has aroused much interest and the idea has been received with much satisfaction by the business men of Fredericton.

The announcement has also brought forth the first statement from the Eel River Light, Heat and Power Co., Ltd., of their plans for the development of the Eel River power. This company was incorporated under an act of the Provincial Legislature passed at the last session, the incorporators being Messrs. John and George Murchie and F. W. Andrews, of Charlotte county, Messrs. H. A. Connell and George McPhail, of Woodstock, and R. G. Lee, of this city.

Mr. Lee is the secretary of the company and last evening he stated that this summer the company has spent about $6,000 ascertaining the available power for development and that the results have been highly satisfactory. While the Eel River stream itself is not large, it drains a great watershed, having a 70 foot head, while behind it are seven lakes, one of which is eight miles long. This summer, under the direction of Mr. H. S. Ferguson, of New York, surveys have been made of the district and a report has been made to the company.

Mr. Ferguson is one of America's leading consulting engineers specializing on water powers and acts in that capacity for the Great Northern Paper Co. at Millinocket, Me. His report is to the effect that with an expenditure of $300,000 there can be developed [illegible] horse power per year, which is more than enough to supply a city of 100,000 population, supposing the power was used for all purposes, while the development of a smaller [illegible] of power would naturally mean a smaller expenditure on the part of the company.

It is the intention of the company to supply power for Fredericton, Woodstock, St. Stephen and McAdam, at the latter place supplying the C.P.R. shops, etc., and it is said that negotiations already contracted with the [illegible] Company have been very encouraging and that there is reason to believe that the company will sign a contract for using a large quantity of power annually for various purposes. The report is that the pole lines extended down to the city of Fredericton next summer," said Mr. Lee, "and if the people of [illegible] need power for their business and for general purposes they will [illegible]

It is stated that at an early date negotiations will be begun with the City Council for the acquisition of the company's power for [illegible] the street lighting plant as well as the waterworks pumping station and that a proposal will be made to the Fredericton Gas Light Company for supplying the power for commercial purposes in this city. Estimates have already been made on the cost of running a pole line from Eel River to the head of this city and the work would cost about $64,000, it is said. Mr. Lee said that some of the actual work of development would have been commenced this year by the company had it not been that the work of the engineers in making their surveys and completing their reports took longer than anticipated, the report having been submitted only very recently.

TRADE NOTES.

W. H. Allen, Son & Co., Ltd., Queen's Engineering Works, Bedford, England, have decided to establish an agency in Canada, as the result of Mr. R. W. Allen's visit to Canada last spring. They have made arrangements with Chapman & Walker, Ltd., Toronto, to represent them. With them will be associated Mr. Mieville, a gentleman who has been a member of Messrs. Allen's staff for a number of years. He will be attached to the agency as engineer, and will prepare specifications and tenders, superintend the erection, conduct the trials and hand over all machinery of his firm's manufacture, in perfect running order. The Allen Co. specialties are high speed engines, centrifugal and turbine pumps, steam turbines, condensing plants, etc.

At the Windsor Hotel, Montreal, **The Robb Engineering Co., Amherst, Nova Scotia,** are installing three Robb water-tube boilers of 200 H.P. each, and three Robb-Armstrong vertical 2-crank compound engines, 14 and 20x8, for direct-connection to electric generators of 150 K.W. capacity each. These engines are to run at 435 revolutions per minute.

The Canadian Crocker-Wheeler Co., St. Catharines, Ont., made the largest single shipment of transformers since its establishment. It consisted of eighteen transformers, six of which are of 200 k.w., while the remainder range from 75 k.w. to 250 k.w. The aggregate of the shipment was in the neighborhood of 6,000 k.w. The largest transformers go to Winnipeg to be installed in the municipal light plant there, while the others go to various points in the province. Though it has not been established here quite a year, the factory has one hundred and fifty employees on its payroll. The manufacturing capacity has been nearly reached, and by next spring it is altogether likely that a large addition to the present plant will have to be built.

The Robb Engineering Co. has recently taken the general agency for Canada of the gas engines and suction gas producers made by Davey, Paxman & Co., Colchester, England, who are well known in connection with the latest developments in internal combustion motors. The Paxman gas engine is made in a full line of sizes from 2½ to 300 horsepower; those larger than 20 horse power are equipped with a compressed air self starter, which starts the engine with the same ease and certainty as a steam engine. Full information regarding these gas engines and producers may be had of any of the Canadian offices of the Robb Engineering Co.

The Whyte Packing Co., Stratford, Ont. recently installed two Redfield standard cast iron double effect evaporators made by the Brecht Co., New York. These evaporate the liquor from the lard process and cooking departments. The resultant "stick" (heavy liquid) passes to a revolving dryer and is were installed under the supervision of W. G. Walters, chief engineer of the Whyte Co. then made into fertilizer. The evaporators

The John McDougall Caledonian Iron Works, Ltd., have commenced the manufacture of both plunger and electric elevators, for both passenger and freight purposes. To this end they have secured the services of Mr. Thure Larson, who previous to this appointment was for many years chief engineer of the Standard Plunger Elevator Company, of New York. Along with him they have also secured the control, in Canada, of the Larsson elevator patents, which are considered extremely valuable. For the plunger elevator these patents include a new main valve, designed to eliminate bounding of the car when stopping, a new automatic terminal stop valve, and a new pilot or control valve which prevents any accidental movement of the car in the opposite direction when passengers are entering or leaving. On the electric elevator patented improvements include the good features of the drum and traction type, and are said to give greater security and economy in operation. These elevators will be built in the company's shops on Seigneurs Street, where they have just completed eleven passenger and freight elevators of the plunger type, with lifts varying from 40 ft. to 176 ft. for the C.P.R. Windsor Station extension.

The Engineering Specialties Co., sales engineers, 1080 King Street West, are handling the "Everlasting" blow-off valve as a special feature. A. W. Given, formerly manager of the Standard Fittings and Valve Co., Guelph, is in charge of the manufacturing and sales department of the enterprise.

CATALOGUES.

The Dodge Manufacturing Co., Toronto, have issued a new catalogue and price list of their cast-iron and wood pulleys, both solid and split, now so well known to power users. This company has exceptional facilities for making heavy cast-iron pulleys and fly-wheels up to 20 feet diameter. All pulleys are machine moulded and may be made with either single or double arms. It is by their wood pulleys that the firm is probably most widely known. A complete stock of these is always on hand in all sizes from 4 inches up to 6 feet diameter. The catalogue is very complete and contains several pages of useful rules on belting, etc.

The Cling-Surface Co., Buffalo, have issued a handy little book for the use of superintendents, engineers and beltmen. It is entitled "The Belt Book," and explains the economies to be expected from the use of this well-known belt dressing.

The Crocker-Wheeler Co., Ampere, N.S., have sent us their newly published booklet dealing with Induction Motors. The booklet describes in much detail the special features of the C.-W. Motors.

We have received two bulletins from the **Allis-Chalmers Co., Milwaukee, Wis.** Bulletin No. 1080 describes their well-known alternating current generators of the revolving field type, and contains numerous illustrations of large installations. The Allis-Chalmers alternators for direct connection to steam engines are made in two types, viz.: standard engine type and fly-wheel type. The standard engine type alternators are designed to meet the electrical operating conditions and requirements without special reference to the fly-wheel effect of the rotor. The engine fly-wheel, which is mounted on the shaft alongside the generator, supplies the additional fly-wheel effect required. The fly-wheel type alternators, however, are constructed with the field poles mounted on the face of the engine fly-wheel, which serves the double purpose of fly-wheel and rotor spider. This type is applicable only to large sizes, since the rotor must be of large diameter to give the necessary fly-wheel effect.

The generators are too well and favorably known to require extended notice here. Bulletin No. 1512 describes the equally well-known Allis-Chalmers compound Corliss engines, which the company builds in all sizes up to 10,000 H.P., or larger, if wanted. Cross, vertical and tandem compounds are all illustrated in the bulletin.

The General Machinery Co., 526-527 Traders Bank Building, Toronto, who are Canadian agents for the Bogart Gas Power Engineering Co., Buffalo, have forwarded us some illustrated literature descriptive of the lattter company's various types of gas engines. These comprise single cylinder stationary gas engines from 3½ to 60 H.P., centre crank tandem gas engines, having enclosed beds and fitted with crossheads, and centre crank tandem gas engines having open type beds and no crossbeds, running from 30 to 120 H.P. The company also manufacture single (two cylinder) and double (four cylinder) tandem heavy duty gas engines of from 100 to 600 H.P., with crossheads and variable lift valves. These are adapted for driving electric generators DC or AC, either belted or direct-connected. The double tandem engine consists of two single tandem sets, right and left hand, driving on one shaft. The cranks are set opposite each other, and have the timing of the valve-operating gear so set that the shaft receives two impulses at each revolution. The builders recommend this type for driving multi-phase high frequency generators in parallel and all other work requiring a closer regulation than can be had with a single tandem, two-cylinder unit.

The bulletins sent us are well illustrated and show reproductions of the more important details, such as valves, valve gear, governor, etc. In addition, a full description is given of each type of engine.

BOOK REVIEW.

Steam Turbines—By Joseph W. Roe, A.S.M.E., A.I.M.E., Assistant Professor of Mechanical Engineering, Sheffield Scientific School, Yale University; 143 pages, 6x9 inches, illustrated; published by the McGraw-Hill Book Co., 239 West 39th St., New York.

This is a short treatise on the theory, design and field of operation of steam turbines and has been written to provide a text-book suited to a short course on the subject in engineering schools, and also to provide a book for the engineer on the principles and general design of turbines, without going into refined treatment of the more difficult problems entering into that design.

The author treats of all types of turbine and at the end of each section gives a list of references to other works on the subject. The mechanical problems of construction are fully dealt with, and there is an extremely interesting chapter dealing with the relative economy of steam engines and turbines.

"ECLIPSE" BOILER ENAMEL

"ECLIPSE" BOILER ENAMEL IS A THOROUGH PREVENTATIVE OF THE FORMATION OF BOILER SCALE, PITTING, CORROSION, FOAMING, ETC., IN ANY WATER.

No new scale can form in any boiler in which "Eclipse" is correctly used.

Old scale is quickly removed by its action.

WRITE FOR LIST OF USERS, THEN WRITE THEM FOR FULL INFORMATION REGARDING THE EFFICIENCY AND RELIABILITY OF THIS SERVICEABLE BOILER ENAMEL.

Write at once and LET THE USER CONVINCE YOU before you buy. His testimonial will be a great advertisement to us.

BOILER PROTECTION

In "Eclipse" Boiler Enamel we have a preparation which gives no heed to the class of water used, but in every case puts a filmy coating over the heating surfaces of the boiler, which makes it absolutely impossible for solid matter in any form to adhere to the iron. The scale-forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler in the form of a soft, soapy mud which will not burn or blister, and is most readily blown from the boiler.

OUR PROPOSITION

The following letter, which accompanies every trial shipment of "ECLIPSE" BOILER ENAMEL, speaks for itself:

Messrs..... Winnipeg.....

Gentlemen,—We have shipped you this date .....bbl. "Eclipse" Boiler Enamel, which, when used according to directions contained in our booklet, must give you entire satisfaction in your plant, otherwise you will not be required to pay for same. We leave it to your own sense of fairness to see that "Eclipse" gets a square deal. Under these conditions we are sure of the result.

"Eclipse" Boiler Enamel is guaranteed to be absolutely harmless to the boilers or the fittings. Being harmless, it is slow in its action on old scale, but it is deadly sure. Yours very truly,

Send for our booklet to-day

W. W. CARRUTHERS

388 Edmonton Street, WINNIPEG, Man.

AGENTS:—J. A. Cartwright, 616 Wellington St., London, Ont.; A. J. Chamberlain, 52 Colborne St., Toronto, Ont.; J. H. Elliott, 42 Fort St., Montreal; W. L. Magee, Middleton, N. S.

The highest grade lubricants are always the most economical, as they give better returns for money invested.

Lubricants of Superior QUALITY

We manufacture lubricants that are unequalled for quality and efficiency—this has been proved through our many years of successful business.

We also recommend "Sliptivity" Machine Oil.

Send us a trial order—satisfaction or money refunded.

C. C. Snowdon, Wholesale
P. O. Box 1384 CALGARY, ALTA.

A Certain Saving in Fuel Costs

is always the result from using

"WALSH" BOILER COMPOUNDS

We make a specialty of the hardest and most difficult cases of scaled and pitted boilers, especially those in which many other compounds and mechanical devices have been tried and proved absolutely worthless, and we ask only a fair and impartial trial of our goods.

This compound is guaranteed to remove all scale without injury to the tubes; that the same action will prevent corrosion and preserve your boilers.

Send us a sample of scale, about two ounces, or half a gallon of your feed water for analyzation.

Booklet on scientific treatment of feed waters sent on request.

THE WALSH CHEMICAL COMPOUNDING CO.,
67 Bay St. North, Hamilton, Ont.

DON'T WORRY!

BOILER SCALE

Can Be Easily Removed If You Use The DEARBORN TREATMENT

No scale or scale-forming ingredients can exist where this Feed Water Treatment is used.

Besides eradicating all scale, it acts as a boiler preservative by preventing corrosion and any other boiler troubles due to impurities in the Feed Water.

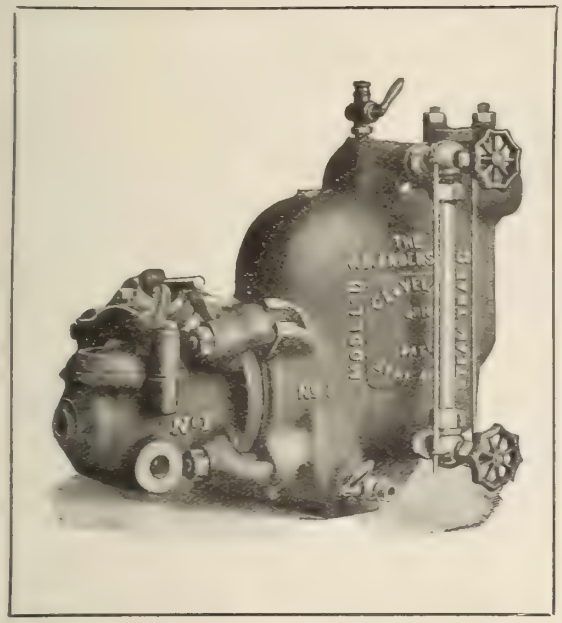
Mr. Engineer, do you not think that a small investment in this guaranteed scale remover would prove a great value to you?

By keeping the tubes absolutely free from scale, Dearborn Treatment has been the means of saving much money by enabling every shovelful of coal to yield its utmost value.

Send us a gallon of Feed Water. We will analyze it and let you know the exact cost of this treatment, made especially for your plant. ***Write To-day***

Dearborn Drug & Chemical Works
GENERAL OFFICES AND LABORATORY **CHICAGO** | EASTERN OFFICES 299 BROADWAY **NEW YORK**

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

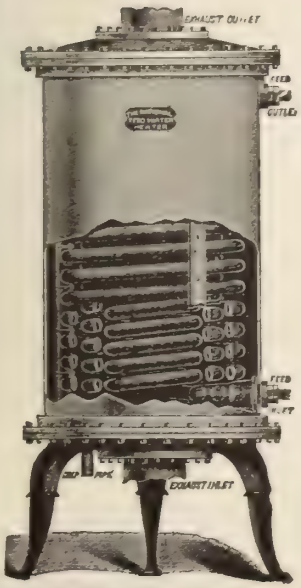
We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

The National Feed Water Heater



Simplicity and Durability

are two of the essentials that go to make a strictly first-class Heater.

Corrosion or Leakages are impossible, as the Feed Water never comes into contact with the shell, and at no time is the shell subject to boiler pressure.

The "NATIONAL" is used in many of the highest grade engine rooms throughout the United States and Canada, and the letters we are constantly receiving prove its reliability and efficiency. These letters are yours on request.

Write for catalogue and full particulars

The National Pipe Bending Co.

91 Lloyd Street

NEW HAVEN : CONN. : U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,

—FOR—

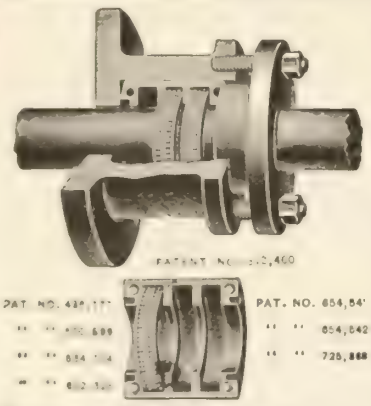
MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys, Solid and Split Sprockets, Bearings, Gears—Spur, Bevel, Mitre, Shafting, Couplings, Post Hangers, Post Boxes, Take-up Boxes, Boots, Boot Pans, Shaft Hangers, Friction Clutches, Belting, Belt Tighteners, Buckets, Sprocket Chain Attachments, Car Movers and Pullers, Iron Work for Dumps, Spiral Conveyors.

Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
SEND US YOUR SPECIFICATIONS.

THE MANITOBA BRIDGE AND IRON WORKS, LIMITED
WINNIPEG, MAN.



Why not Buy the Best, when in market for Packing?

HOLMES'
Metallic Packing
is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

HAVE YOU WRITTEN for a Free Half-pound Bar of Stephenson Bar Belt Dressing? This bar is large enough to give a convincing trial and is often an introduction to initial orders. After the first order the others follow as a matter of course.

The genuine Stephenson Bar Belt Dressing always bears this trade mark:

This dressing has been on the market for nearly twenty-five years and is an established article. It is carried by the prominent dealers of Canada.

Write us to-day for a Free Half-pound Sample.

STEPHENSON MANUFACTURING CO.

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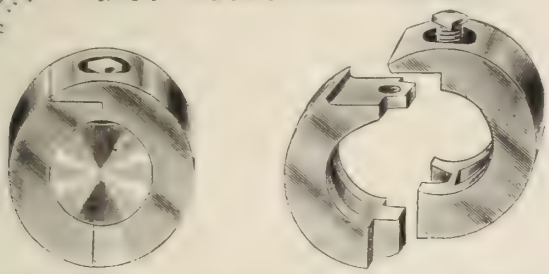
MAKE ASSURANCE "DOUBLE SURE"
AND TAKE "A BOND"

"BOND" SAFETY SPLIT COLLAR



The Bond Patent Universal Ring Oiling Hangers.

Our Regular Frames will also accommodate Wick Oiling, Grease and Graphite Bearing.

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Babbitted and Reamed Bearings.

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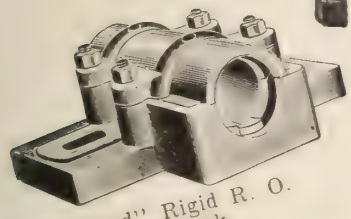
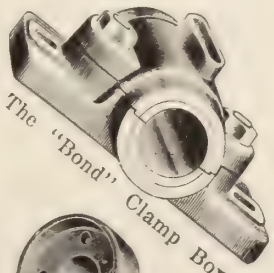
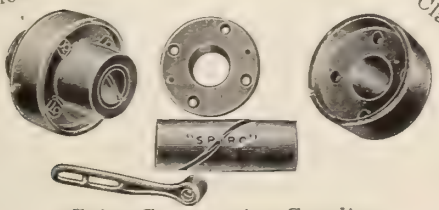
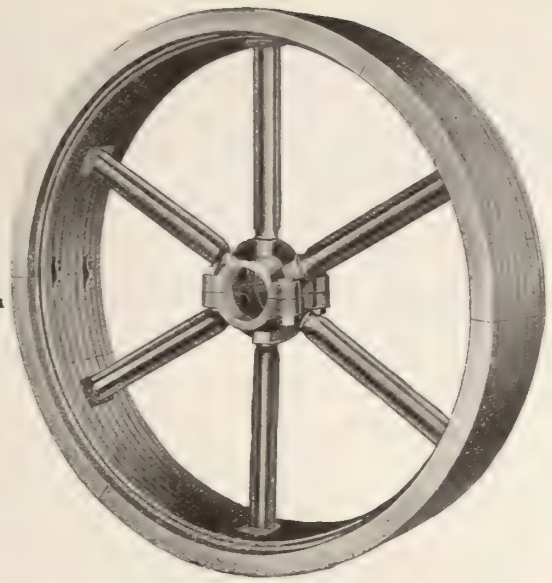

The "Bond" Rigid R. O. Pillow Block.


The "Bond" Clamp Box



Spiro Compression Couplings

CANADIAN BOND HANGER & COUPLING CO., Limited
MANUFACTURERS
ALEXANDRIA - - - ONTARIO.



The Pulley that Pulls the Load

All pulleys pull. Some pull more, others less; some pull willingly, others under protest; some pull for a longer time, others for a shorter; but they all pull some, and pull something. What interests users of pulleys most is: what do they pull?

"Sounds simple enough," you say. Yet, let's get right down to the dollars and cents argument—and the sensible one, too—as that is the basis upon which all business is conducted, and investigate. Pulleys either pull with the virile strength of a properly designed, well-balanced, all-around sinewy build, or with the half-hearted effort of constitutional weakness; they either pull with the highest efficiency attainable, or else, in so far as they fail, pull on your bank account.

"What must I look for in a pulley—not to pull on my bank account?" you ask. The build is the answer. It's the build of a pulley that makes for its efficiency. The POSITIVE Combination Split Wood Rim Steel Center Pulley has maximum belt contact, extreme lightness, great strength, perfect balance, lowest possible windage, powerful compression and will stand fast rim speeds—every possible factor that can enter into the high efficiency of a pulley—because of its build. Compare the construction of any other pulley—cast iron, steel or all wood—with the POSITIVE Pulley. Take each item named above and see if other types can boast of *all* these high-power features.

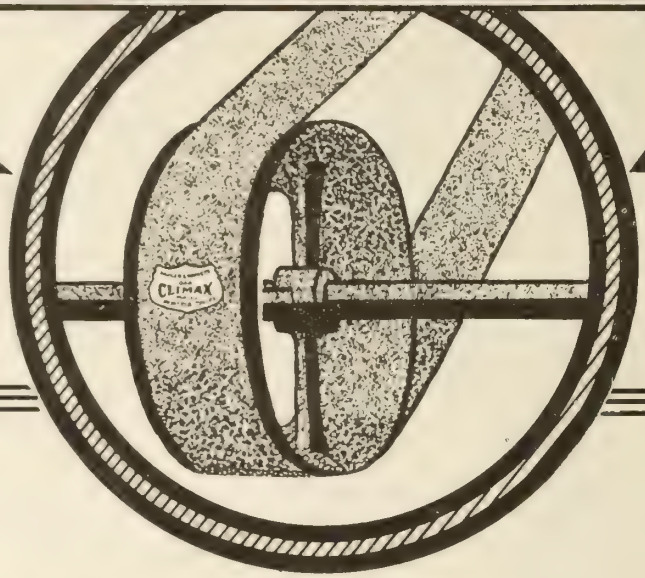
You'll find other pulleys can't, don't have them *all*—because of their build. You'll find that the POSITIVE Pulley is the only pulley that pulls with the highest efficiency attainable; is the pulley that does not pull on your bank account; is the pulley that will satisfy you better—far better—because it has the build which makes it The Pulley That Pulls the Load.

The Positive Clutch & Pulley Works
LIMITED
Toronto, - Ontario

American Works: Buffalo, N.Y.

Eastern Representatives and Warehouse: Canada Ford Co., Limited Montreal, Que.

CLIMAX BELTING



Stretches Less

Never Slips

Only The Choicest Leather Is Used In Its Manufacture

This, combined with the great care taken in tanning and stretching' enables us to place our unlimited guarantee on every finished product that leaves our works.

Mr. Manufacturer, a reliable Belting means much to the up-to-date machine shop.

"CLIMAX" Belting is absolutely reliable and efficient, and will transmit with certainty all the power that your engine can develop.

It will save you time and money, as the stretch is less than on other Beltings, and thereby requires less time for tightening.

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Sadler & Haworth

For 34 years the Makers of the Best Belts

MONTREAL, 511 William Street TORONTO, 27 Melinda Street

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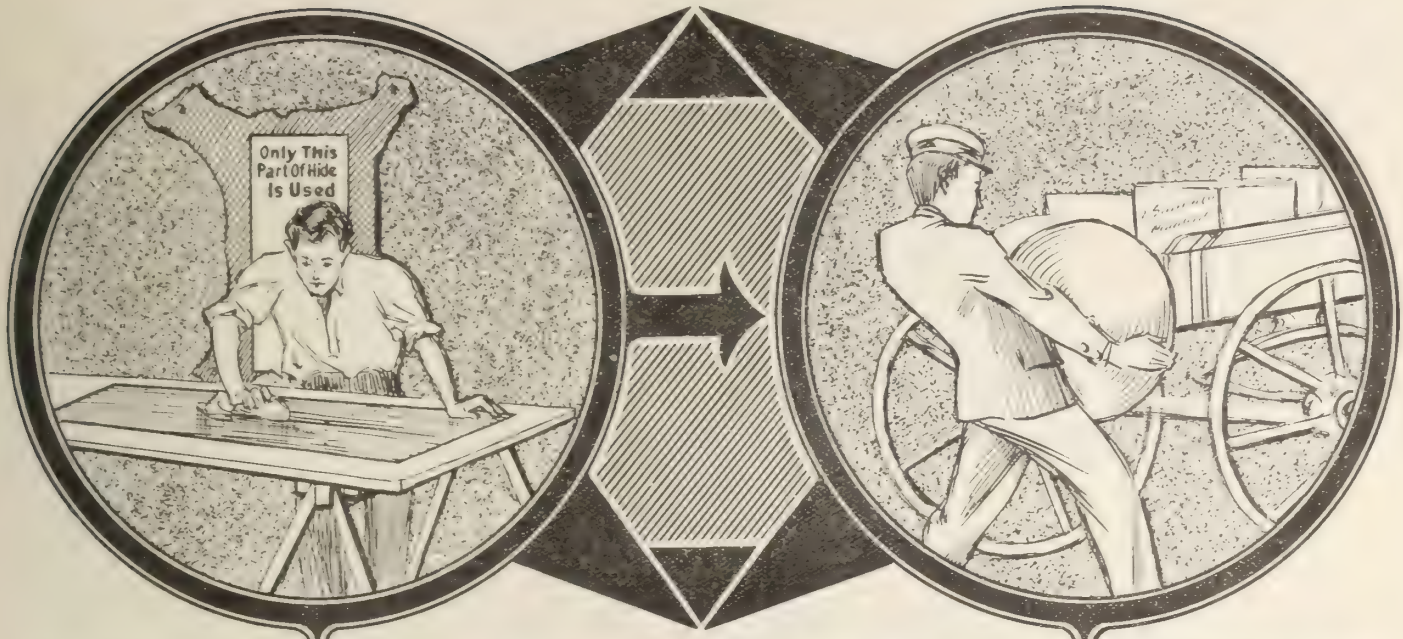

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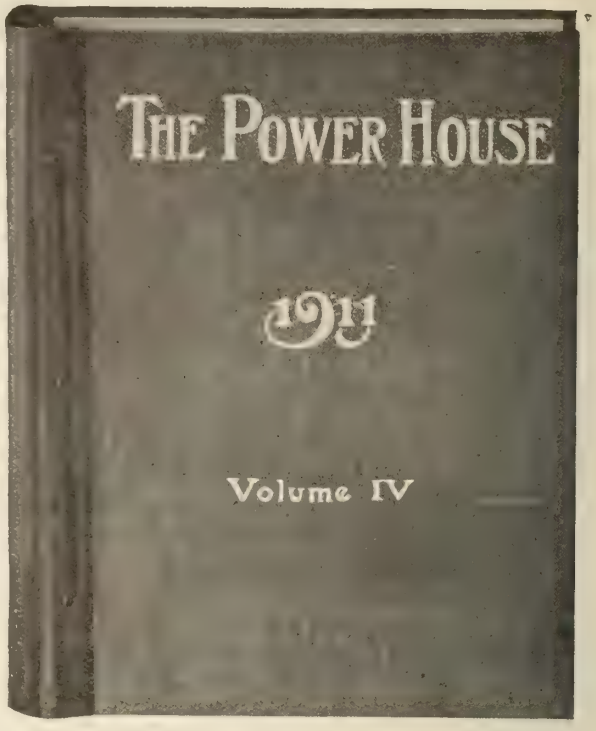

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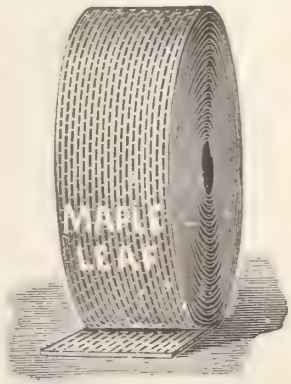

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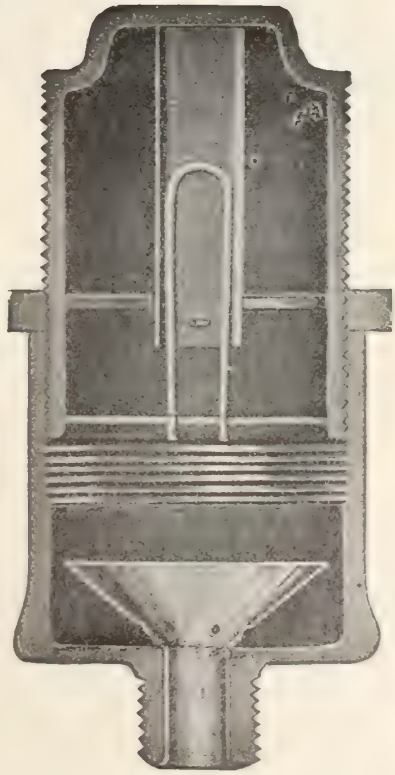

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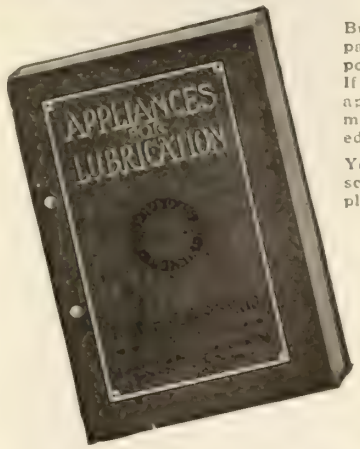

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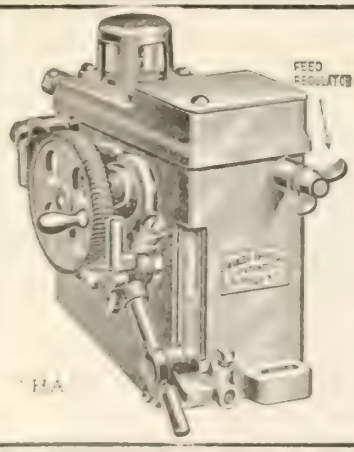

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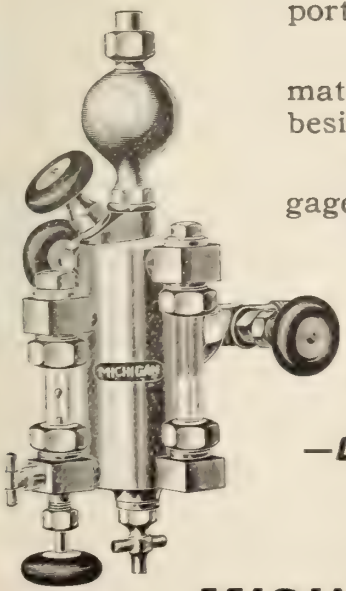

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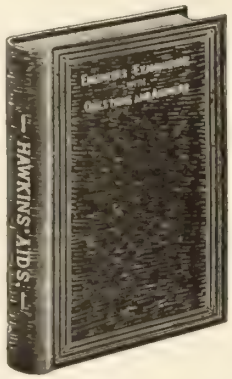

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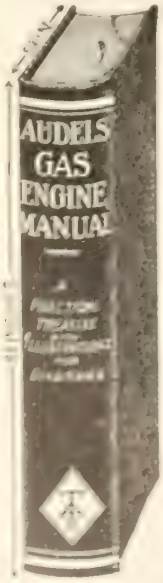

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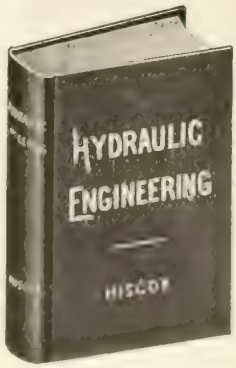

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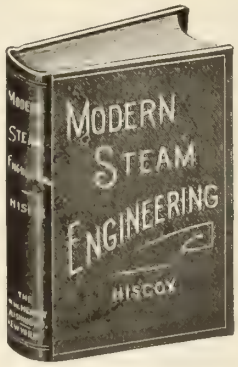

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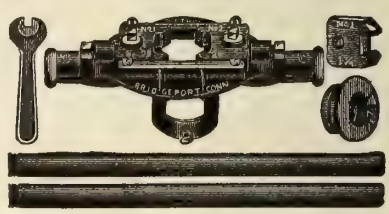

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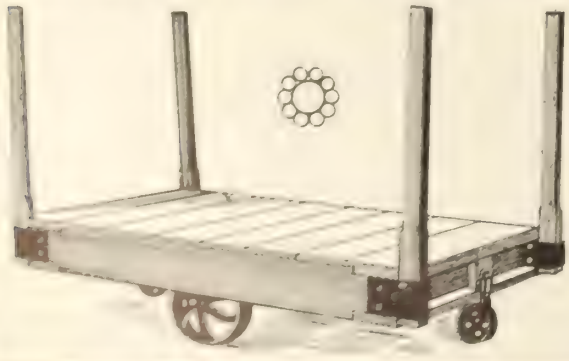

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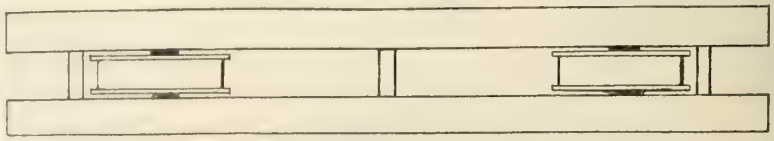

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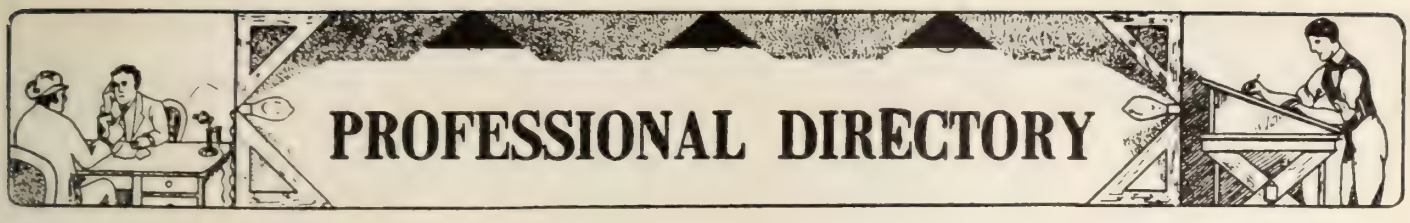

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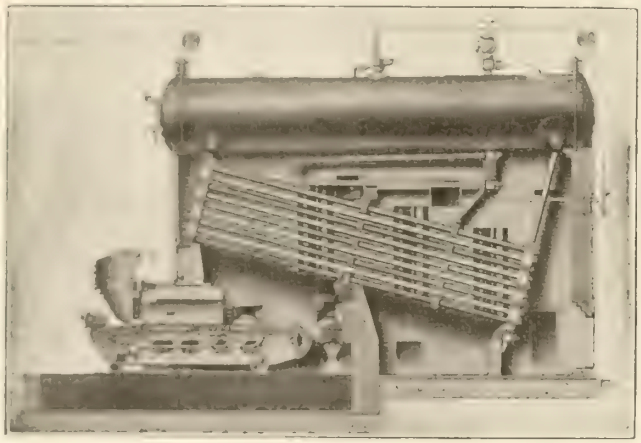

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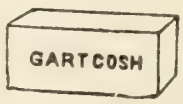

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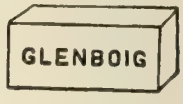

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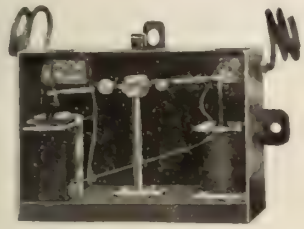

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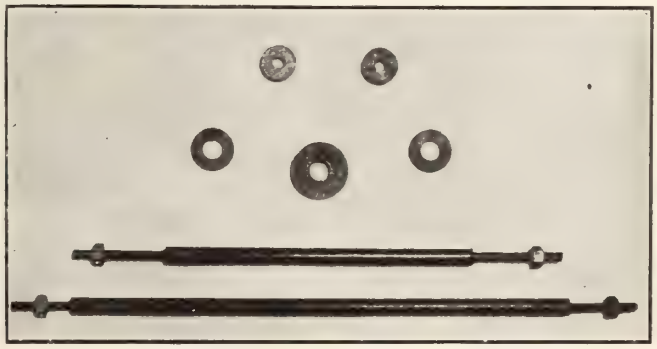

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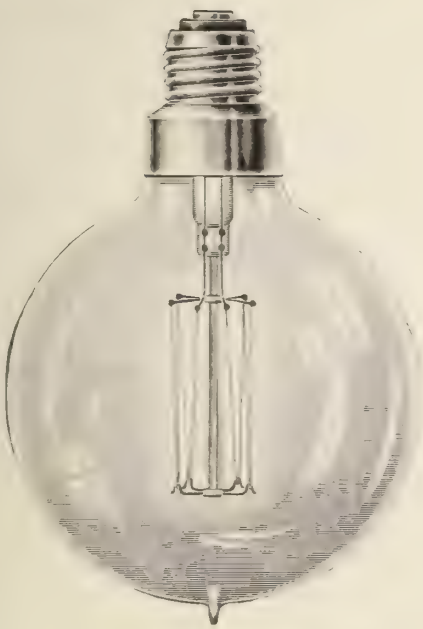

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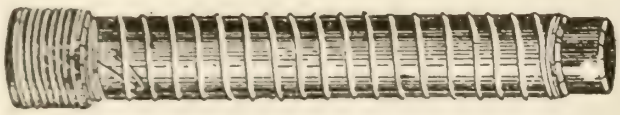

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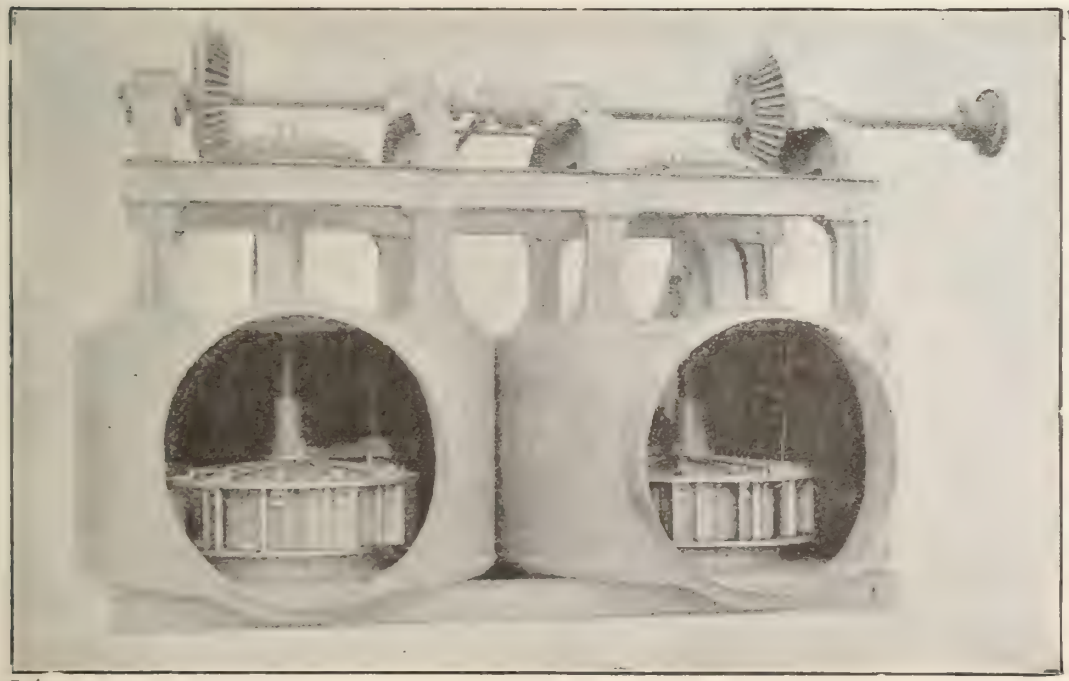

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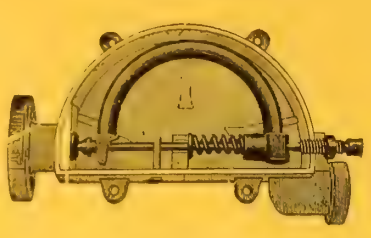
The "HEINTZ"  Steam Saver

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BY USING
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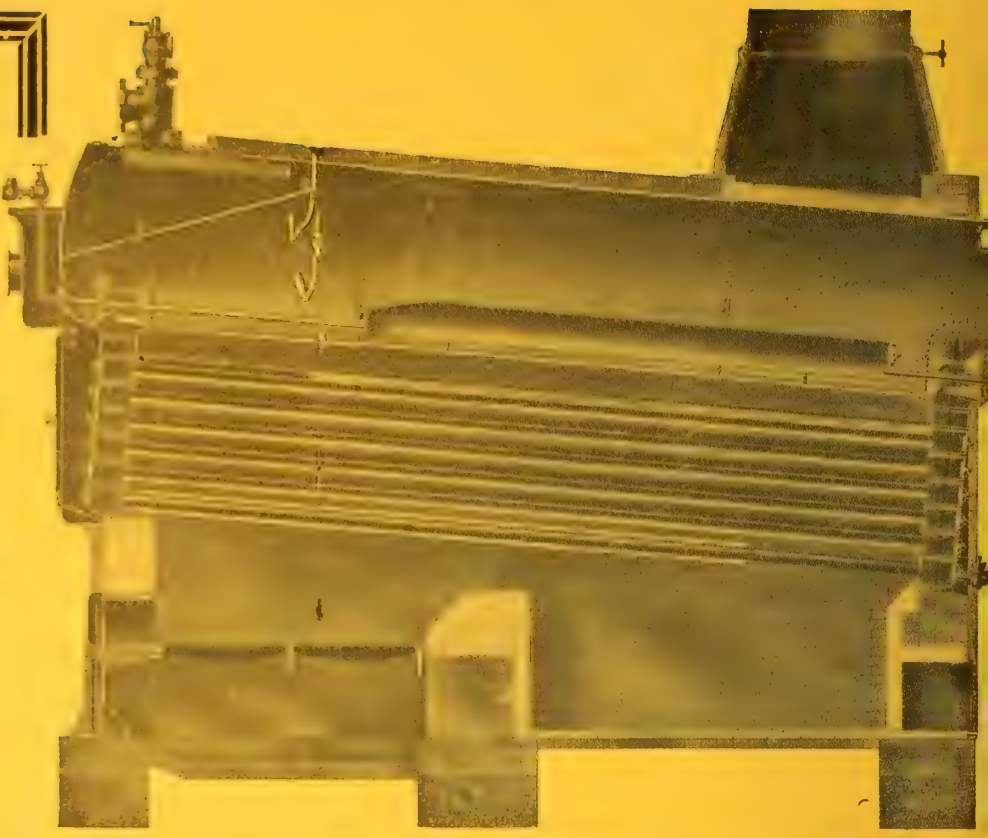
"Heine"



SAFETY BOILER

Don't keep on using a boiler if it is running your engine room into unnecessary expense by allowing the heat to go to waste.

The "Heine" Safety Boiler is not only constructed so as to best absorb the heat, but also that the heat may best reach it.

It is the most economical in use of fuel, as it delivers the greatest quantity of dry steam for each pound of fuel burned in the furnace.

The "Heine" is guaranteed to be absolutely safe, as it is thoroughly tested under high pressure before leaving our works.

The "Heine" Mud Drum is constantly at work keeping the boiler free from all mud and scale-forming matter.

Write us for Catalog and full Information.

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B F. Sturtevant Co., Hyde Park, Mass., U S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, England, Marine Motors

McEWEN ENGINES
HIGH-SPEED AUTOMATIC

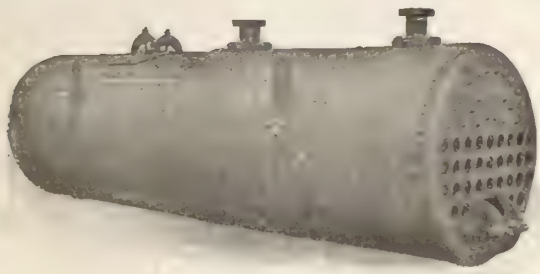
These Single Valve, Automatic Engines are entirely Canadian built.

Ability to stand up under hard usage is their distinguishing feature. Compactness of design, careful selection of materials, combined with constant and rigid inspection of every part during construction, ensure strength and exceptional reliability in the finished engine.

Turned out in simple and compound units up to 700 H.P., their particular field is driving electric generators for lighting, power, street railway and mine haulage

Write for Bulletin.

WATEROUS, BRANTFORD, CANADA.



WATEROUS BUILT RIGHT BOILERS

With designs standardized by hard and fast laws, the only point we can make our boilers different from the other fellows' is in **workmanship**—and we do that.

Finest materials, skilled workmen, modern tools and equipment, and rigid and careful inspection of the work, enable us to to turn out boilers with a finish that marks them as "WATEROUS" built before you see the name plate.

We manufacture **Marine, Stationary,** and **Portable Boilers** in all sizes.

Write for Prices and Delivery.

WATEROUS, BRANTFORD, CANADA.

WATEROUS
STEAM PLANT
EQUIPMENT

Building boilers and engines of the highest quality, as we do, it is to our best advantage to see to it that our steam plant equipment throughout is kept up to the same standard.

Therefore, we not only supply steam plant equipment that is "good enough," but that is absolutely second to none on the market.

With designs that are thoroughly up-to-date in respect to efficiency, simplicity and in operating economy, we combine the very best workmanship possible — *good* men, good materials and good tools.

PENBERTHY INJECTORS
CIRCULATING PUMPS
EXHAUST HEADS
BACK PRESSURE VALVES
FEED WATER HEATERS
STEAM SEPARATORS
FEED PUMPS
WATER PURIFIERS
BAROMETRIC CONDENSERS.

Write for Our Catalogues.

The Waterous Engine Works Co., Ltd.
BRANTFORD, CANADA.

REMINDER

to write to Bell Filtration Co., 305 Kent Building, Toronto, for free copy of their book "Filtration and Softening of Water."

TEAR OUT ALONG THIS LINE

We Guarantee to Filter though Others Fail

Where slow sand filtration or imperfect mechanical methods have failed, consult us.

"The Bell Filtration Co. accepts orders only where they can guarantee results" gains point when we state that we have never refused an order for fear of not being able to live up to our guarantees.

BELL'S Patent, Vertical Mechanical Pressure **FILTERS**

make 97 per cent. purification of water a practical possibility. The percentage of filtration is often higher.

Write us for our handsome free book on water.

BELL FILTRATION COMPANY

OF CANADA, LIMITED

305 Kent Building, TORONTO, Ont.

Western Office:
150 Princess Street
WINNIPEG

Eastern Office:
188 Peel Street
MONTREAL

U.S.A. Office:
18 East 17th Street
NEW YORK

Clipping from fifth column, first page of the TORONTO GLOBE for Friday, October 6th, 1911.

POLLUTED WATER WILL REACH INTAKE

Dr. Nasmith Lays Plain Facts Before Board of Health.

CRITICISES SAND FILTER.

Says Plant City is Building is Antiquated.

Director of Municipal Laboratories Gives Result of Extensive Investigation Which He Has Made Into the Water Supply.

"The water off Fisherman's Island will be a great mass of water polluted with at least 28,000,000 gallons of fresh sewage every day."

"From what I have seen this summer I have little doubt but that at times this polluted water will be carried to and beyond our present intake, or any other intake that may be subsequently laid."

This is a bomb which Dr. G. G. Nasmith, Director of Municipal Laboratories, hurled at a meeting of the local Board of Health yesterday, and he followed it with another to the effect that—

While the city has been occupying two years in building a filtration plant, the advance of science has declared the plant an antiquated piece of machinery.

On this point he said:—

"The rapid and general acceptance of methods of sterilizing water during the past two years have made sanitarians regard the slow sand filter, which up to that time was unquestionably the best purification method we had, in quite a new light. The slow sand filter was intended to filter out the suspended matter and bacteria from the water. Its efficiency depends absolutely on the care that is exercised in construction and operation. Carelessness in operation will allow bacteria to get through, and the filters are expensive to maintain. A mechanical filter, which is much cheaper in construction and will remove all the suspended matter and 90 per cent. of the bacteria, is just as good a preliminary to any method of sterilization as the more expensive sand filters."

The sand filtration plant at the island will cost about $750,000, and is expected to be finished by the end of this year.

BOILER REQUIREMENTS

Have you considered if your boiler requirements are sufficient for this season?

We have a good number of standard sizes in stock and for immediate shipment.

EITHER HIGH OR LOW PRESSURE.

ASK FOR CATALOG.

The Jenckes Machine Co., Limited

General Offices: SHERBROOKE, QUE.

Works { SHERBROOKE, QUE. ST. CATHARINES, ONT.

Sales Offices: SHERBROOKE, MONTREAL, ST. CATHARINES, COBALT, SOUTH PORCUPINE, ROSSLAND, VANCOUVER

BLACKBURN-SMITH FEED WATER FILTERS

Oil, grease and other foreign matter held in suspension in the feed-water are the causes of serious boiler troubles if not removed. The Blackburn-Smith Feed-water Filter, manufactured by Messrs. James Beggs & Company, will remedy these difficulties. Their filters are in successful service in the largest plants in the United States and Canada.

Canadian Sales Agents:

EADIE-DOUGLAS LIMITED

Montreal **Toronto** **Ottawa** **Winnipeg**

Ye Users of Water-Tube Boilers and Others as Well

PAY ATTENTION TO THE COAL WASTED

The Average Management figures closely on the first cost of coal, but as soon as it is delivered straightway begins to waste it.

Men who pay the Coal bills are slow to discover the saving that can be maintained by a clean boiler.

You can burn a lot of coal and make a little steam, or you can burn a little coal and make a lot of steam. It all depends upon the cleanness of the heating surface.

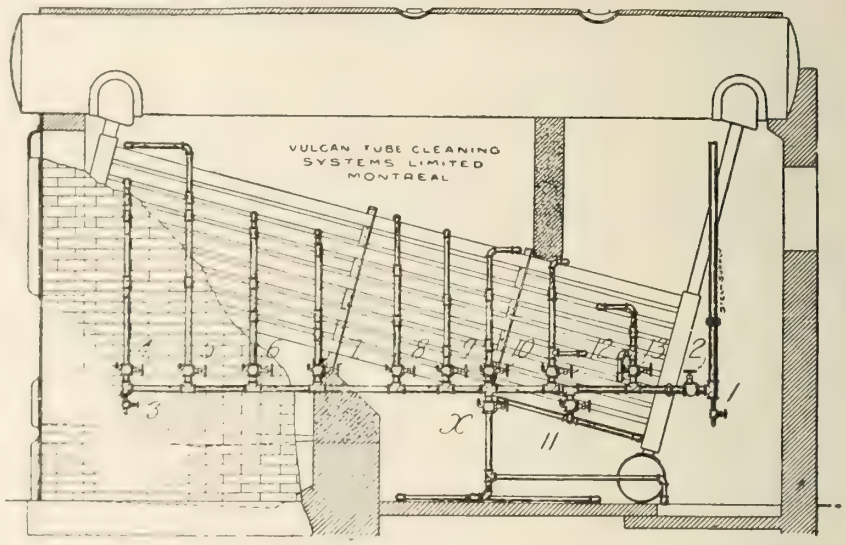
If you positively knew that your stack temperature was 150 degrees higher than it ought to be, and that the evaporation was correspondingly low, would you investigate the matter? YOU SURELY WOULD.

Such conditions actually exist in steam plants where soot is fought by hand.

Soot stands foremost as the greatest non-conductor of heat. Soot is continually formed from fuel in the process of combustion, and is therefore unavoidable. The only solution is to use a

Vulcan Soot Cleaner

A Soot Cleaner with Brains



Saves coal, labour and steam hose. Prevents air leakage—prevents boiler strains.

You can never appreciate a clean heating surface until you make comparisons between the old way of cleaning tubes and the Vulcan Way.

Write for Our New Book

"Economical Steam Production," just off the press—an elaborate treatise on the subject of soot and the Vulcan Soot Cleaner—it's free—use the Coupon

For Every Type of Boiler—WATER-TUBE OR TUBULAR.

Vulcan Tube Cleaning Systems, Limited

4-11 Bonsecours St., - MONTREAL

SIGN, TEAR OUT AND MAIL

Vulcan Tube Cleaning Systems, Limited, Date.....
4-11 Bonsecours St., Montreal.

Please send us, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.

[It is important that the following information be given in full.)

Water Tube Boilers.

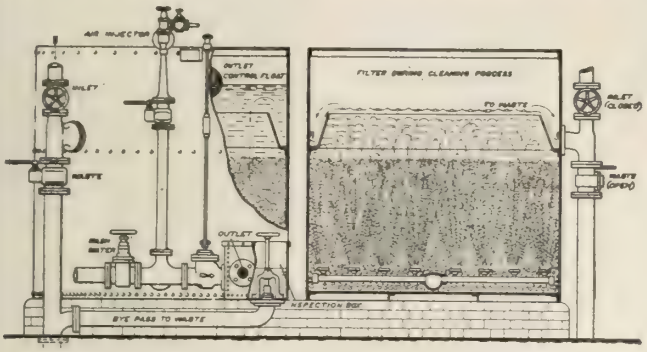
No. of Boilers..... Type..... Pressure.....
Horsepower..... No. Tubes High.....
Superheaters?..... Width of Alley at side.....

Tubular Boilers.

No. of Boilers..... Horizontal or Vertical.....
Name.....
Address.....

"PETERSON"

FILTERS PURIFIERS



In use for purifying water for the largest Municipal and Industrial Plants in England.

Write to Us for the
"Peterson" Red Book on Water Softening and Purifying.

Laurie & Lamb
CANADIAN AGENTS.

"LAURIE PATENT"

"EFFICIENT" FEED WATER HEATER

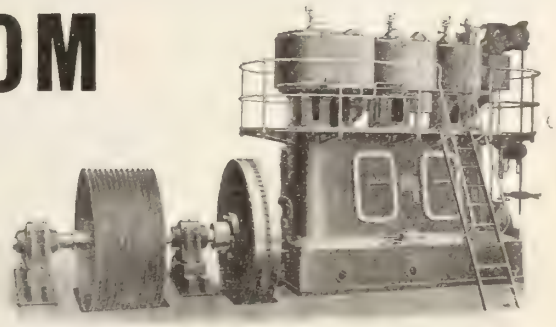
Seamless drawn Brass Tubes.

Cast Steel Tube Sheets.

Construction allows of **free expansion of tubes.**

Laurie & Lamb
212 Board of Trade Bldg.
MONTREAL.

BELLISS & MORCOM



ENGINES

Forced Lubrication.
Lowest Oil Consumption.
Guaranteed Steam Economy.
Noiseless running.
Simplest Compounds and Triples on the market.

TURBINES

Impulse type, **avoiding close clearances** over the vanes.
Drum Construction, with consequent **rigidity.**
Through Shaft utilized to obtain **perfect alignment.**
Blades, each one **held** secure **independently from others.**
Lubrication and Governing, of **Belliss Standard** for their reciprocating engines.

AIR COMPRESSORS

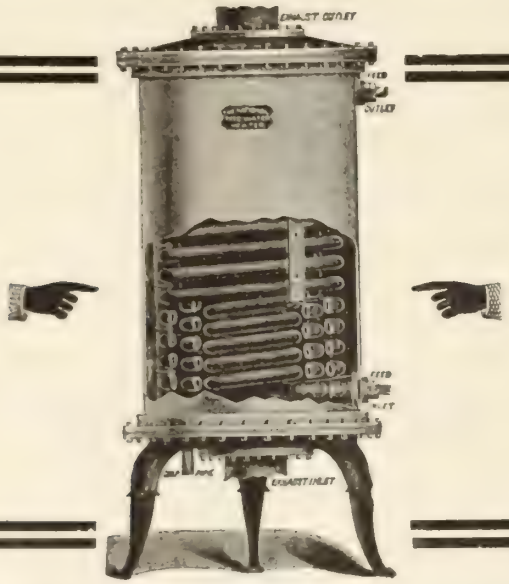
Extreme Simplicity. Compact design. Overall Efficiency.

AGENTS:

Laurie & Lamb

211-212 Board of Trade Building - - - MONTREAL

The National Feed Water Heater



Means a Certain Saving Wherever Installed

as the exhaust steam takes the part of fuel, and heats the water to a boiling point at no cost.

The "National" is a very simple heater, yet the most effective. It has no inside joints to leak, and the water does not come in contact with the shell or iron.

Prevents all grease from entering the boiler, and is the best insurance against back pressure.

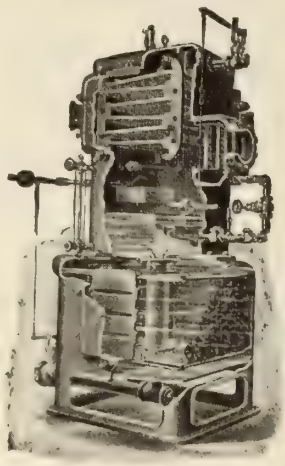
If you wish to save money, write us at once.

CATALOG ON REQUEST.

The National Pipe Bending Co.

91 Lloyd Street, NEW HAVEN, CONN.

A Pure Boiler Feed Water Is Essential to Economy



You can't get over the fact that impure water will soon interfere with the efficiency of your boiler and seriously add to your fuel consumption. There is only one way to insure boiler efficiency and fuel economy---that is, purify your boiler feed with a

WEBSTER FEED WATER HEATER, PURIFIER and FILTER.

Let us make one specially suited for the feed water used in your boilers. Almost every case calls for special treatment. Our capacity and experience is indicated by the fact that over 3,000,000 h.p. of Webster Heaters are in use to-day.

WRITE FOR LITERATURE.

Darling Bros., Limited

15 Ottawa St. - MONTREAL, P.Q.

Toronto, Ont. St. John, N.B. Winnipeg, Man.
Vancouver, B.C., Frank Darling & Co., Agents.

The "OTIS"

TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER

SAVES FUEL

by harnessing the exhaust steam that would otherwise go to waste, making it heat the water to boiling point before the latter enters the boiler.

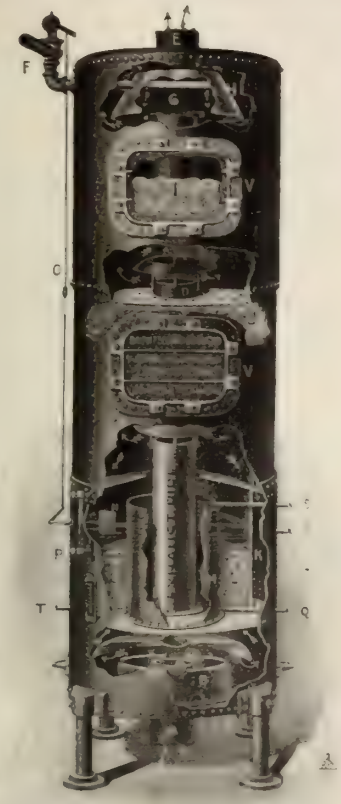
It does its work rapidly and regularly, and is so simple that it cannot get out of order.

The "OTIS" extracts all oil from the exhaust, and will furnish steam for further heating purposes, if desired.

WRITE FOR DESCRIPTIVE CATALOG AND PRICES.

The Stewart Heater Co.

189 Norfolk Ave., Buffalo, N.Y., U.S.A.



"DAKIN"

Feed Water Heater, Purifier and Oil Extractor

This Heater is of the "open" type, in which the entering water is heated to about boiling point by coming in contact with the exhaust steam before entering the boiler. The water passes through three filtering chambers, which frees it from all impurities, with the result that the boiler is kept cleaner and its economy increased greatly.

MADE BY

E. LEONARD & SONS, LONDON, ONT.

MANUFACTURERS OF

High and Slow Speed Engines of all types for all purposes. Boilers of all kinds built to pass all Provincial Inspection Laws.

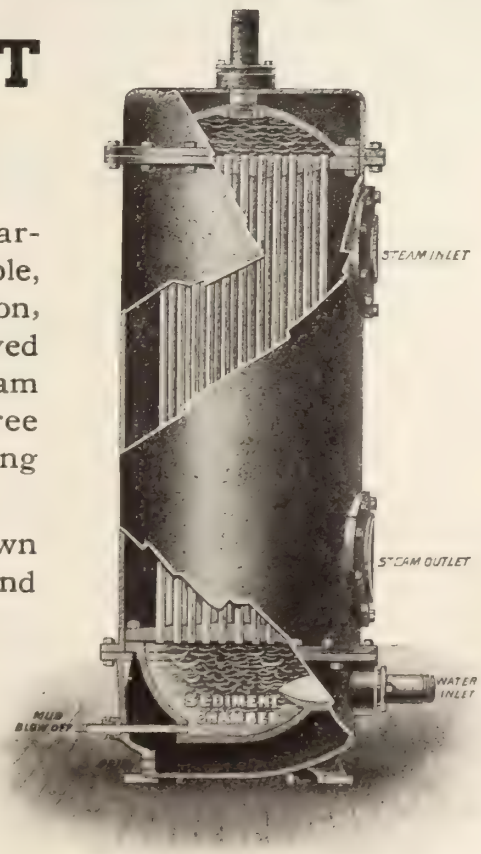
WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

MACKIE PATENT HEATERS

There are many heaters on the market, but no other heater so accessible, where the whole inner tube section, complete with heads, can be removed without disconnecting the main steam piping, and when in operation be so free to expand and contract with varying temperatures.

The tubes are made of seamless drawn brass, the heating surface is liberal, and the material and workmanship throughout are of the highest class.



For Boilers, Laundries, Hotels, Hospitals.

Built and designed for any service, Vertical or Horizontal, High or Low Pressure, moderate or large storage capacity.

Goulds Pump Company

National Trust Bldg. TORONTO.

Coristine Bldg. MONTREAL.

TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

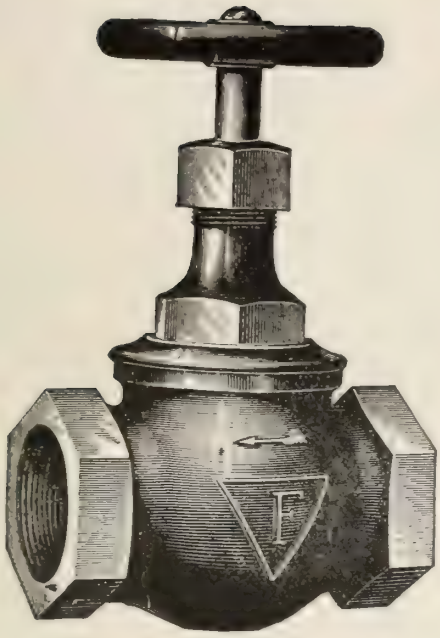
If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL



FAIRBANKS VALVES

"The World's Standard"

Will appeal to the discerning buyer. They are widely known and popular among all engineers—and deservedly so. In design they are simple—in construction and composition only the finest workmanship and best-grade bronze have been used. They are heavily built and well proportioned, being fully capable of standing rough treatment and any pressure up to that specified for each valve.

WE SHALL APPRECIATE YOUR
FURTHER ENQUIRIES

THE CANADIAN FAIRBANKS-MORSE CO.
LIMITED

Fairbanks Standard Scales—Fairbanks-Morse Gas and Gasoline Engines—Safes and Vaults

Montreal, Toronto, Winnipeg, Vancouver, Calgary, St. John,
Ottawa, Saskatoon.

WE ARE SPECIALISTS IN RELIABLE ENGINEERING GOODS

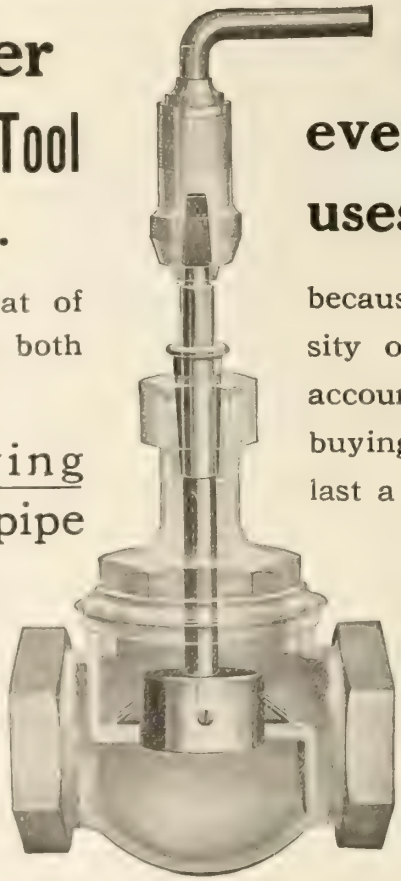
The Skinner Valve Re-seating Tool

is one of these.

Fits and re-cuts the seat of any globe or angle valve, both flat and taper,

without removing them from the pipe line

and in perfect alignment —a new valve for the old in a few minutes — no trouble, no expense, and a tight valve.



PAT. APPLIED FOR

Should be in every plant that uses globe valves

because it eliminates the necessity of breaking pipe lines on account of leaky valves. Saves buying new valves. Should last a lifetime.

The application is simple and can be used by anyone about the plant.

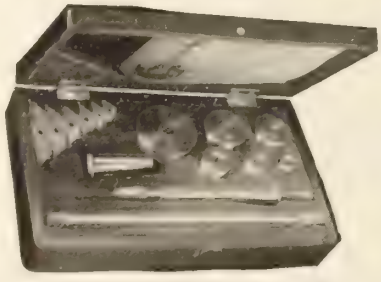
The bonnet nut and the valve opening are the guides, assuring perfect alignment.

Prices : For valves ½ in. to 2 in., $20., ½ in. to 3 in., $30., f.o.b. Montreal

CAN YOU

afford to be without a set at this price?

They will pay for themselves in half a dozen applications.



Each set is complete and comes packed in neat wooden box (see cut). All material is fine steel. highly polished.

Canadian Distributors :

H. L. Peiler & Company

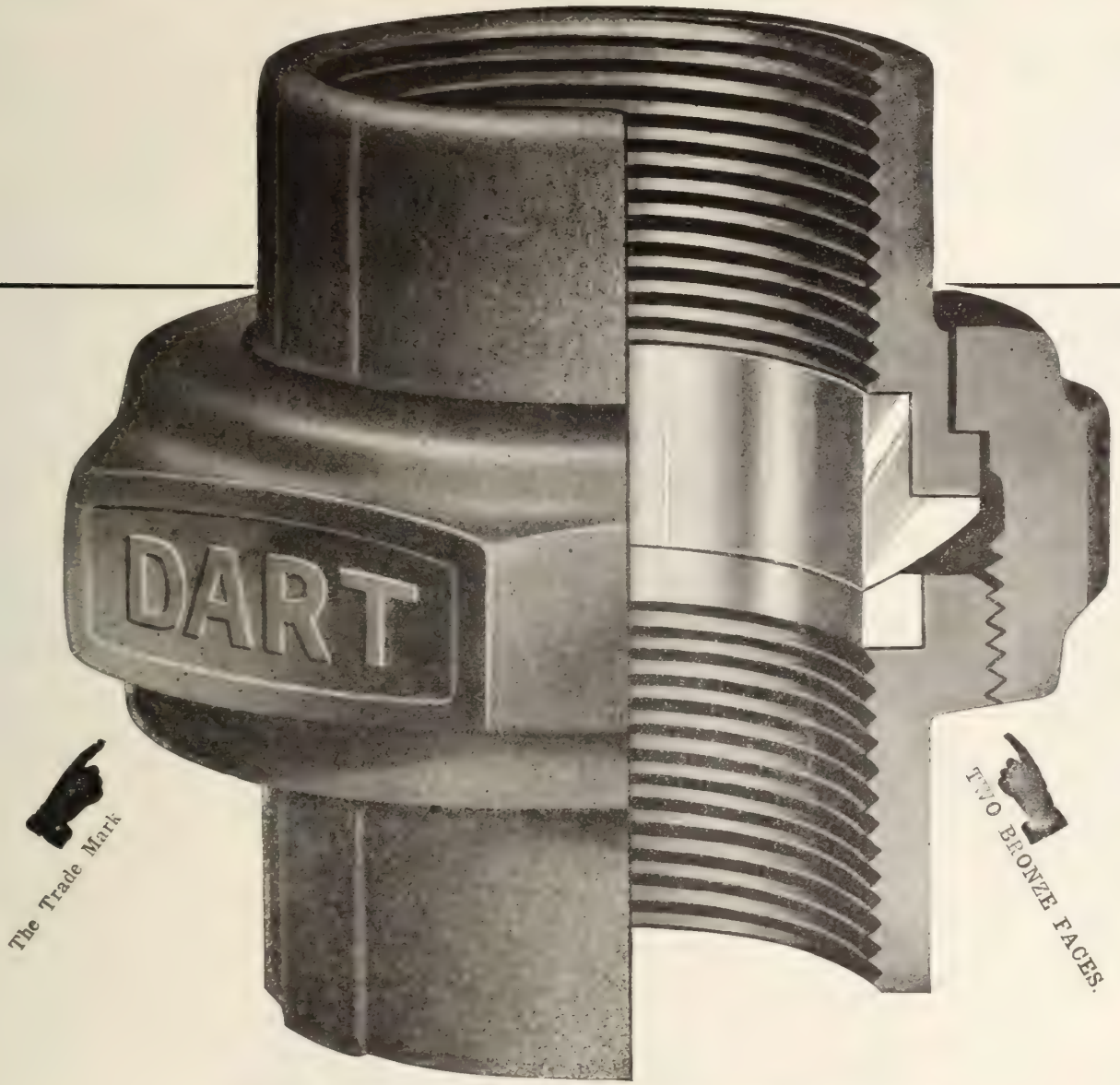
69 Adelaide St. E. TORONTO

380 St. James St. MONTREAL

McLeod Building MONCTON, N. B.

Western Agents: W. E. Skinner, Limited, 618 Somerset Bldg., WINNIPEG

"DART" Unions Save in the Up-keep Costs and Eliminate Union Replacements



The "DART" Union, with a quarter section cut away to show its construction.

The Bronze fully prevents all rust or corrosion on either face of the joint, so that the Union stays absolutely tight, yet may be opened and jointed without bother or expense.

No matter how many times a "Dart" Union is joined, it makes a joint that stays tight until deliberately loosened.

THAT MAKES TWO WAYS OF SAVING.—1st. No Cost for Maintenance.
—2nd. No Cost for Replacement.

"Dart" Unions are made in all convenient forms—flanged, tee, elbow, etc., male or female, and we guarantee every "Dart" Union to give perfect satisfaction.

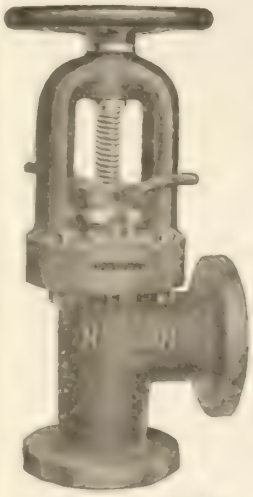
NEARLY ALL DEALERS IN CANADA SELL THEM.

DART UNION CO., LTD. - TORONTO

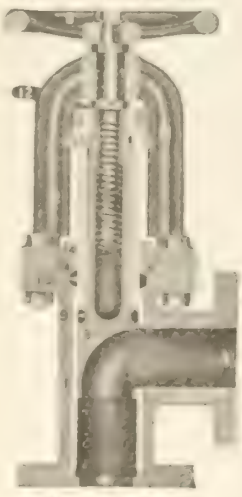
Don't fail to mention this paper in writing to advertisers.

NELSON
TRADE-MARK REGISTERED

Blow-off Valve



(Outside view, closed)



(Inside view, open)

Iron, for 300 pounds working pressure. Steel, for extreme service.

Sizes 1½", 2", 2½" and 3", angle or straightway, screwed or flanged.

Valve cannot be opened suddenly; slow opening prevents sudden and excessive water-hammer.

Because the Yoke (2) is firmly bolted to the Body (1) the Plunger is always perfectly in line. This lets the plunger slide freely, makes the stem operate easily. No sticking—no jam.

The Collar (7) is cast solidly on the Stem, it cannot work loose.

The Stem revolves in the Plunger, composed of Piston (5) and Bronze Sleeve (10) which slides freely, in the bronze-lined Body (1).

Lever wrench (12) (see outside view) engages with Nut (11). This compresses Sleeve (10) on Packing Ring (9), adjusting it to a nicety, when the valve is closed. This wrench cannot be removed from the valve or lost, but can easily be lifted from the nut to get a new "bite."

Packing (13) is compressed by Bolted Gland (14) (more clearly seen on outside view). This packing is adjusted altogether independently of lower Packing (9). Both adjustments are positive, the packing is held securely, practically indestructible, cannot be blown out.

When valve is wide open, the plunger strikes collar (7); when valve is closed the plunger strikes the projection (4) at outlet on the bottom. These limit positively the travel of plunger either way. The plunger is always in sight; you can always see if the valve is open, partly open or closed.

When open, the passage through the valve is as clear and as easy as through a regular ell; little friction, no obstructions, no pockets; scale cannot accumulate; nothing to wear or to get out of order.

No stem packing required. No gasket between the yoke and body of valve, because packing (13) prevents leakage there.

No seats. No discs.

Wire drawing impossible.

The plunger, when closed, presents a bronze face to the [illegible] it holds back. The slight wear at this [illegible] harm, because the packing both above and below the inlet holds tight the fluid. When open, the velocity is directed against the curved end of the plunger, [illegible]

NELSON VALVE COMPANY
Philadelphia, Pa.

Montreal
[illegible]

New York
39 Church St.

Chicago.
17 W. Kinzie St.

Pittsburgh.
[illegible]

Minneapolis,
622 Andrus Building.

Butte, Mont.
56 E. Broadway

San Francisco,
[illegible]

We make nothing but valves, but we make all sizes, [illegible] for every purpose. Gates, Globes, Angles, Cross and Blow-offs. High-grade valves exclusively. No [illegible]

THE "IDEAL" PACKLESS VALVE

Should Interest You, Mr. Engineer.

It is a valve that needs no attention, after once installed, in the way of packings.

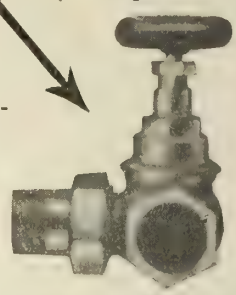
Does away with expenses in keeping up an ordinary valve and prevents accidents that are liable to occur by escaping steam, water, or gas.

It is guaranteed not to leak under any pressure up to 200 pounds.

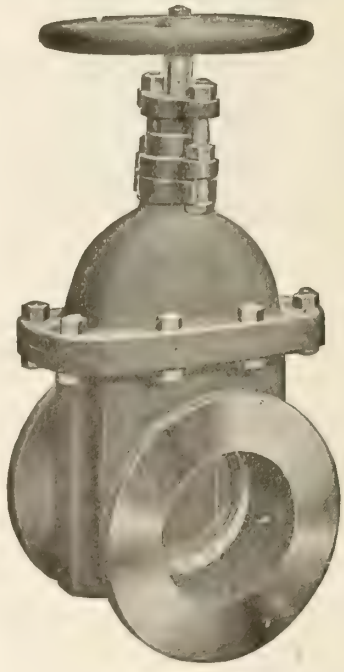
The "Ideal" Packless Valve is neat in design and construction and is made to meet the requirements of every boiler room.

We invite comparison between any of our products and those of other manufacturers whether in material or workmanship.

You will save much trouble by writing us.



The Ideal Packless Valve Co., Ltd.
WALKERVILLE, ONT.



Kerr Gate Valves

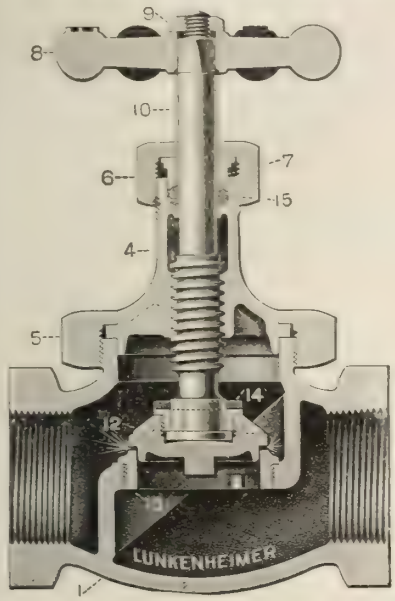
are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO

LUNKENHEIMER "RENEWO" VALVES



ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE.

THE SEATING SURFACES CAN BE RE-GROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED, including the DISC and SEAT. The SEAT is SELF-CLEANSING and is made of a hard, close-grained nickel.

The bronze used contains a high percentage of copper and tin. The improved construction of the disc PRESERVES THE SEATING FACES and PREVENTS WATER HAMMER.

LUNKENHEIMER "RENEWO" GLOBE, ANGLE and CROSS VALVES are made in two patterns—medium and extra heavy—and are guaranteed for working pressures up to 200 and 300 pounds per square inch, respectively. They are made in sizes ranging from ¼ to 3 inches inclusive.

"Most supply houses sell them—yours CAN—if they DONT or WONT—tell US."

The Lunkenheimer Company

Largest Manufacturers of high-grade Engineering Specialties in the World.

General Offices and Works: - - - - - - CINCINNATI, OHIO, U.S.A.

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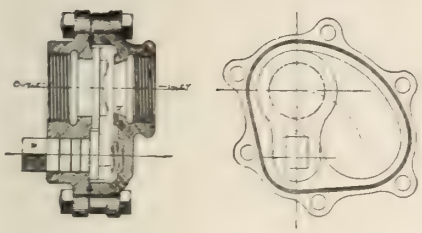
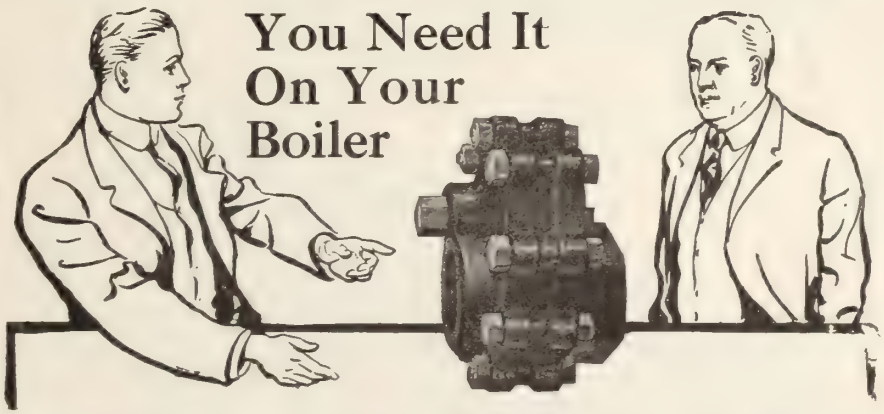
"Everlasting" Blow-off Valve





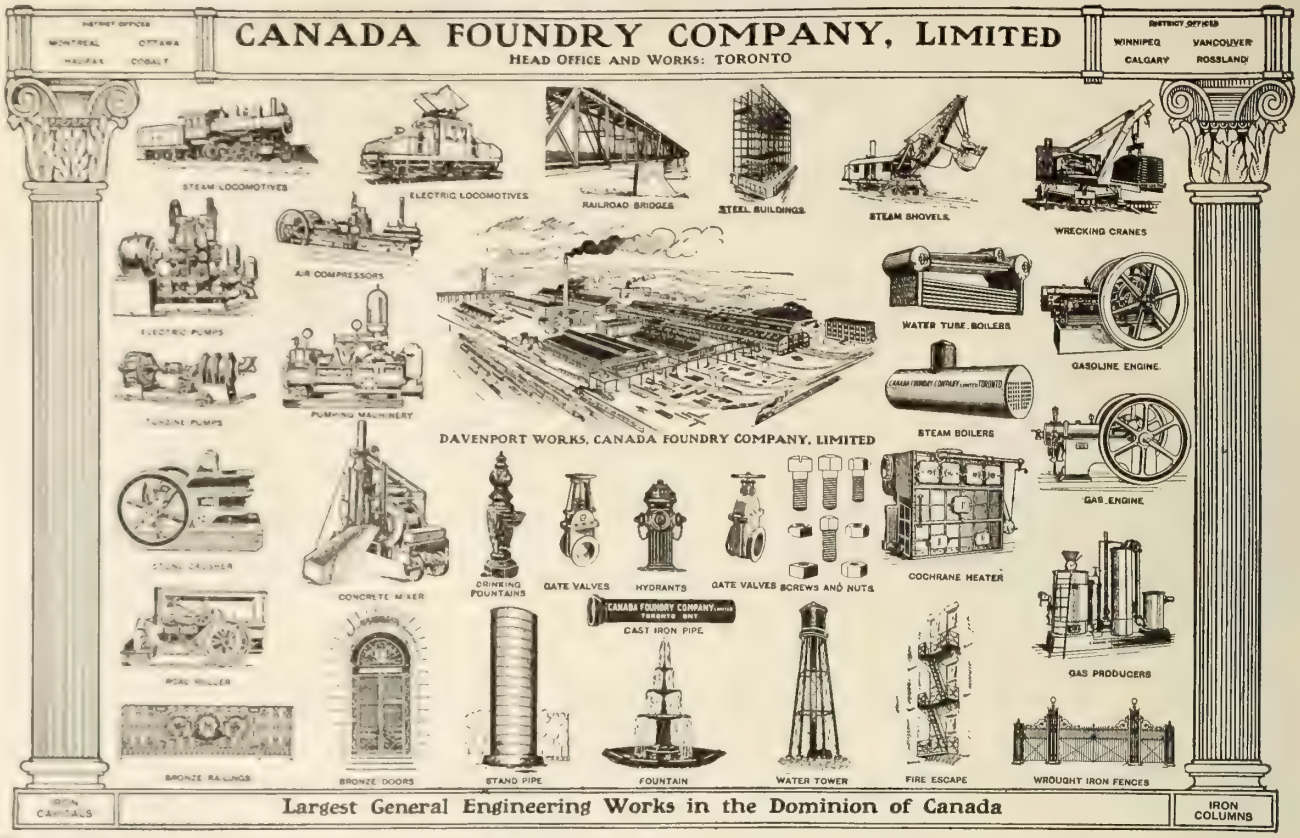
The blow is straight through. The opening is the same size as the pipe. The pressure is all against the disc, not on the spindle. Guaranteed to give satisfaction, and it will. When buying blow-offs insist on getting the "Everlasting." If your dealer does not carry them, write us. We will sell you direct.

EXTRACT FROM A LETTER RECEIVED:

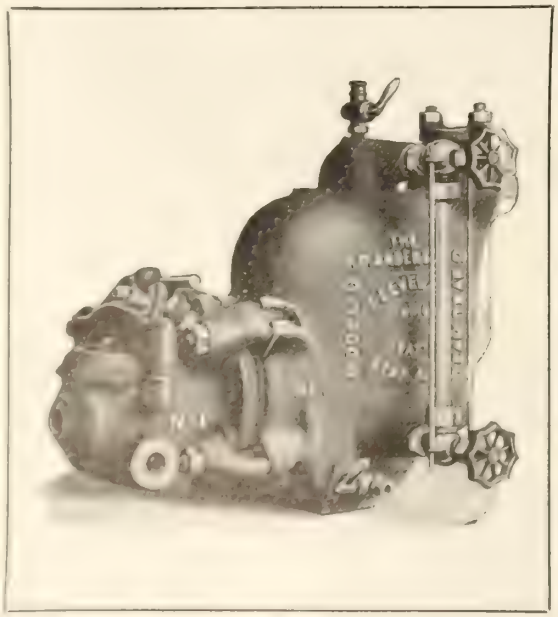
"Our boiler is already equipped with the 'Everlasting,' which has been in service for about three years. It is still giving perfect satisfaction.
—NATIONAL CASH REGISTER CO.

Engineering Specialties Company

1080 King Street West, TORONTO, Canada



The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

Simplicity, Durability and Perfection

are three essentials that place

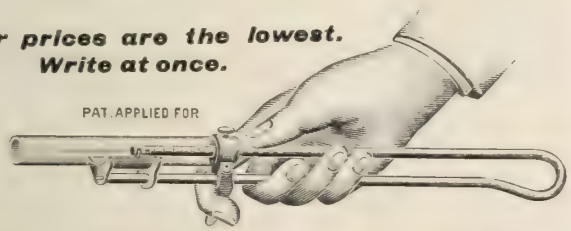
The "FLETCHER"
GAUGE GLASS CUTTER

in a class by itself.

It is constructed in such a manner as to make it the most valuable device for cutting glass tubing at the required length.

Its improved lever attachment with large rest and highest grade Diamond Cutter assure an easy and accurate cut wherever used.

Our prices are the lowest. Write at once.



Worcester Brush & Scraper Co.
WORCESTER, MASS., U.S.A.

QUALITY
Counts in
Gauge Glasses

Bishops ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES

have been tested under all conditions and have proved their superiority over all others.

Write us for Further Particulars

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Mill Supplies **MONTREAL**

IF

you have a bearing that is giving a lot of trouble, why not drop a line and tell us all about it? We have had years of experience and you should take advantage of the knowledge we have gained.

BE ADVISED — CONSULT THE EXPERTS

We manufacture Babbitt Metals for all requirements.

HARRIS HEAVY PRESSURE

The Babbitt Metal without a fault.

It will not crack or squeeze out.

It is copper hardened.

It runs freely.

It makes a bearing that will last and will be found the

BEST BABBITT

for all general machinery bearings. Our guarantee back of every pound.

IMPERIAL GENUINE

for large motors, fans, generators and high speed engines.

The highest grade, high speed Babbitt Metal made.

Specially prepared for heavy engine and extraordinary hard work.

When in doubt

USE IMPERIAL GENUINE

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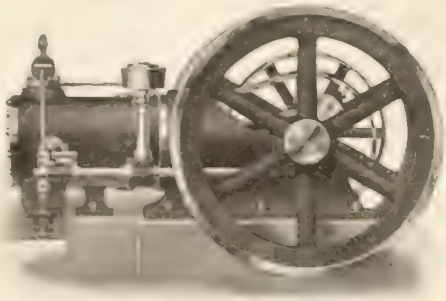
Gas or Gasoline Engines

For Any Service—5 Types.
A Bulletin for each Type.
The Engine for Long Service.



Type "S," 10 to 60 h.p.

State your requirements and let us send our Bulletin.

The General Machinery Co., Limited

526-7 Traders Bank Bldg.
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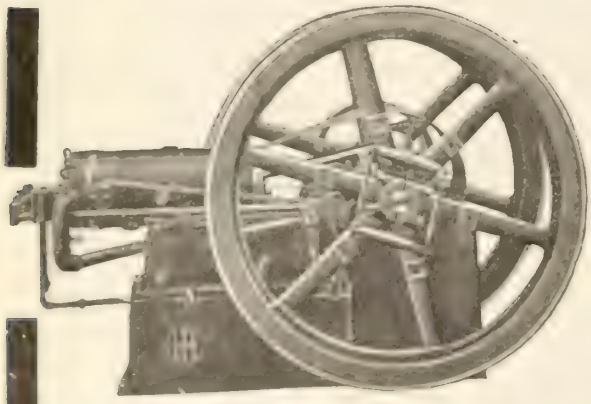

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Engine buyers know I H C means highest quality and biggest value. Supply their demands—make cash profits and gain a good reputation.

I H C
GASOLINE ENGINES

are famous for their reliability, simplicity, economy and durability. Made in sizes from 1 to 50-horse power in many styles.

Write at once for catalogue and complete information.

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ROBB ENGINEERING CO., LIMITED

has recently taken the general agency for Canada of the

GAS ENGINES AND SUCTION GAS PRODUCERS

made by

Davey, Paxman & Co.,
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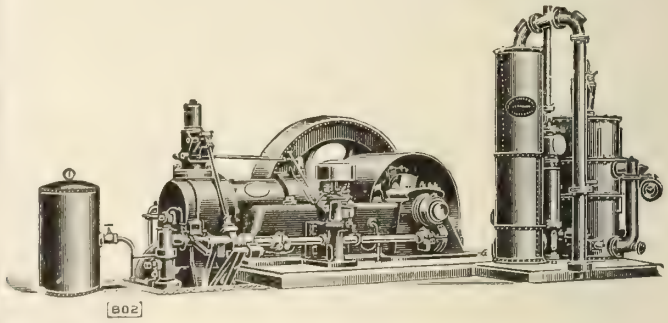
Of COLCHESTER, ENGLAND.



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39-12

AHEAD AND REVERSE

IN one of our recent advertisements showing friction test of MAGNOLIA METAL by the United States Government, using water as a lubricant, you may not have noticed that this test was made both "ahead and REVERSE."

This word "reverse" is small and inconspicuous and very easily overlooked, but the fact, that the engineer officers of the Navy made the test in both directions, shows how important and necessary they considered it in arriving at their determinations.

We believe that it is not generally known that very few babbitt metals will stand reversing, even with oil lubrication, as they rough up on the reverse test like plush rubbed the wrong way.

The fact that MAGNOLIA will stand this test with water lubrication is a wonderful tribute to its antifriction qualities. MAGNOLIA, above all other metals, conditions the shaft and bearings very quickly, imparting to both smooth, highly-polished surfaces, and then settles down for a long, cool run on the minimum quantity of lubrication.

This reverse test speaks volumes in favor of MAGNOLIA.

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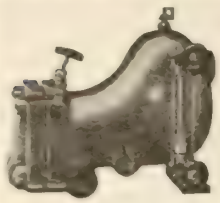
SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK: 680 pages, over 2000 subjects. Price 40c., postpaid. We buy these books in large quantities as an advertising medium and give Engineers the benefit of low price. Engineers commend the book very highly. Address Montreal office.



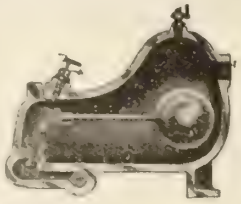
McDANIEL IMPROVED **STEEL TRAP**

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
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WAINWRIGHT WATER HEATERS

A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS are designed specially to fulfill the requirements of Bleacheries, Dyehouses, Paper Mills, Laundries

ALBERGER CONDENSOR CO.
140 Cedar Street, NEW YORK CITY
Agents: CANADIAN FAIRBANKS CO., Limited
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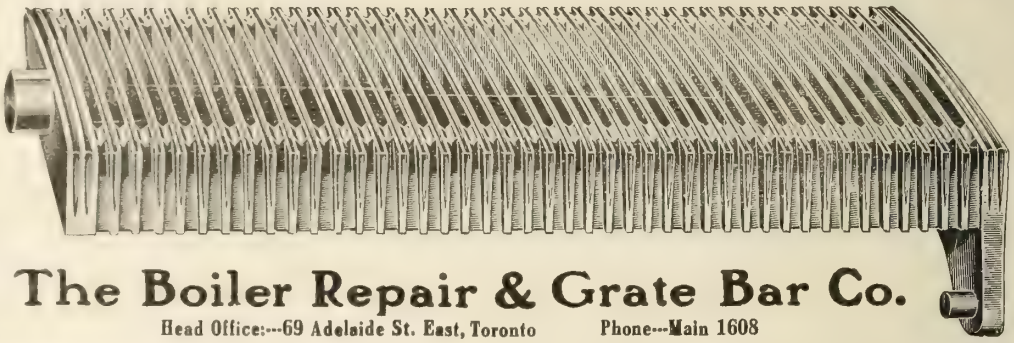
EFFICIENCY AND ECONOMY IN THE BOILER ROOM

We guarantee that we will give you more steam with less coal than you can possibly get with old-fashioned fixed grates.

We supply our grates for all kinds of boilers, brick kilns, gas producers and other furnaces.

Write for further particulars. Estimates free.



20th Century Shaking and Dumping Grate Bar.

The Boiler Repair & Grate Bar Co.
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WITH
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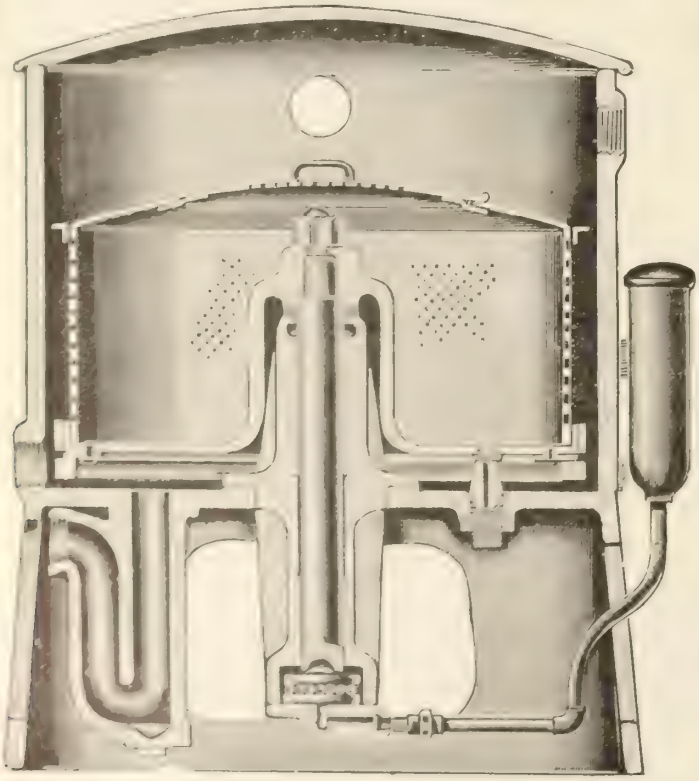

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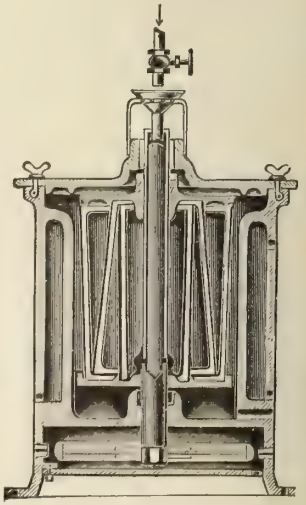
Save Oil—Save Waste

We Manufacture
OIL and WASTE MACHINES, CHIP MACHINES, TURBINE CENTRIFUGAL OIL FILTERS, and CENTRIFUGAL EMULSION MACHINES

TURBINE CENTRIFUGAL OIL FILTER



We have machines with---The E. B. Eddy Co., Ltd.; Grand Trunk Railway; Can. Pac. Ry.; Dominion Coal Co.; J. R. Booth; Toronto Water Works; T. Eaton Co.; Montreal Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oat Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co.; Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.; Consolidated Mining & Smelting Co.; Montreal Cotton Co.; Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd.; J. & P. Coates, Ltd., and many others.

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Shaking and Dumping Grate Bar

The Cyclone Bar has many improvements. See the new centre rib, how it strengthens the centre of the bar and prevents the leaves from warping out of their place. Notice the improved shaking motion whereby we shake the ash off the centre of bar without letting the coal through.

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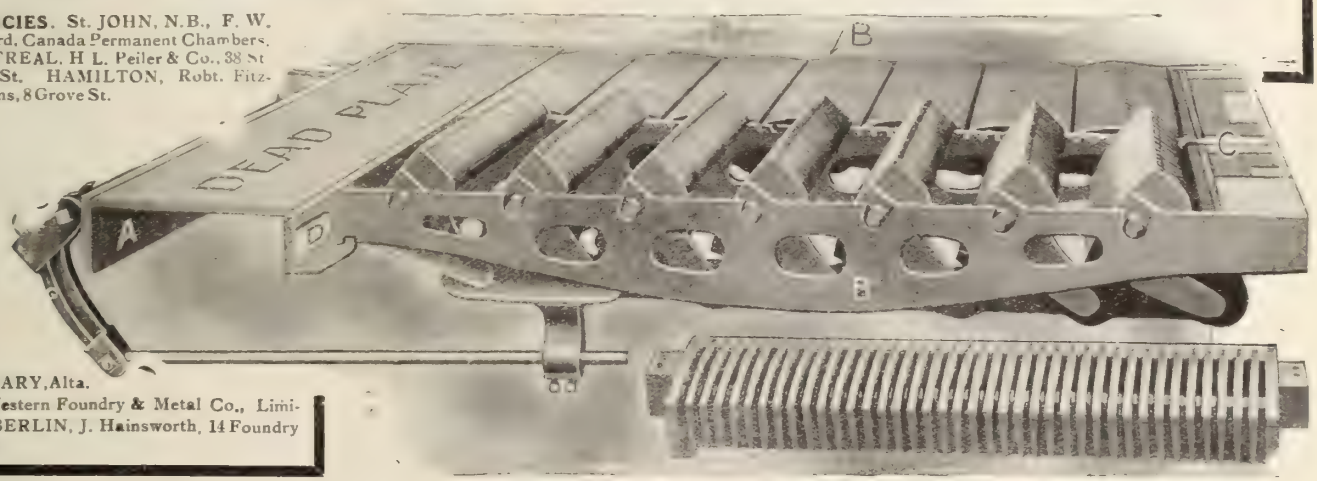

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You Can Keep YOUR RADIATORS Always Hot With A Minimum Fuel Consumption

If you use the "ECONOMIC" VACUUM VALVE. This Valve, being a perfect Steam Trap, can be used equally well on either a gravity or a vacuum system.

It will permit higher temperatures and increased efficiency of Dryers, Dry Kilns, Blast Heater, Coil Stacks, Paper Cylinders, etc., by removing water of condensation.

It also does away with all back pressure on engines supplying the exhaust.

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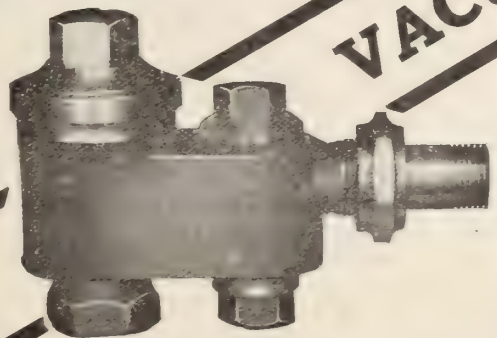

The Valve has two chambers. One, the dirt chamber, where condensation is screened before entering the second chamber or valve proper.

To clean the dirt chamber, simply remove the cap at the bottom and the screened substance will fall out.

This valve is very simple and once used becomes indispensable. The repeat orders and testimonials that we are constantly receiving back this statement They are yours on request. ***Write at once.***

Canadian Steam Boiler Equipment Co. Limited
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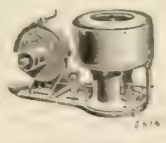
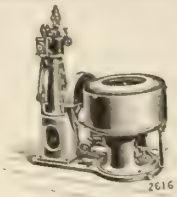

BELT DRIVE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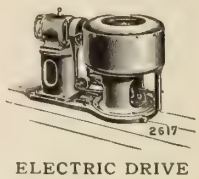
WATER DRIVE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To Meet All Requirements

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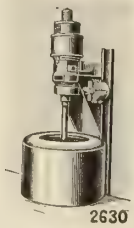
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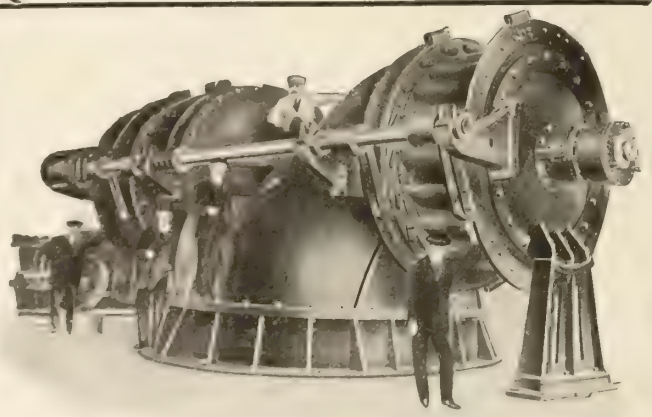

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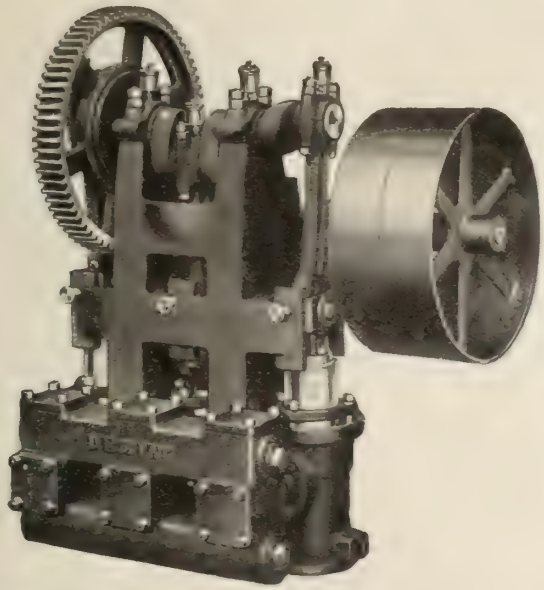
NECESSARY IN POWER PLANTS



Belt Driven Deming Triplex Power Pump. For boiler feeding, tank service, general water supply, etc. Can be direct-connected to motor.

Not only in the "long run" have Deming Pumps demonstrated their money-saving qualities—but right from the start they have "delivered the goods," and in factories where "Scientific Management" is practiced, there you will find Deming Power Pumps.

If you need a pump in your factory, you need our Catalogue. Tell us what you want the pump to do.

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Hand and Power Pumps for all Uses.

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Steam and Power Pumping Machinery

Here are a few reasons why you can purchase Marsh and American Pumps with the confidence that comes only with the feeling that you are getting the very best.

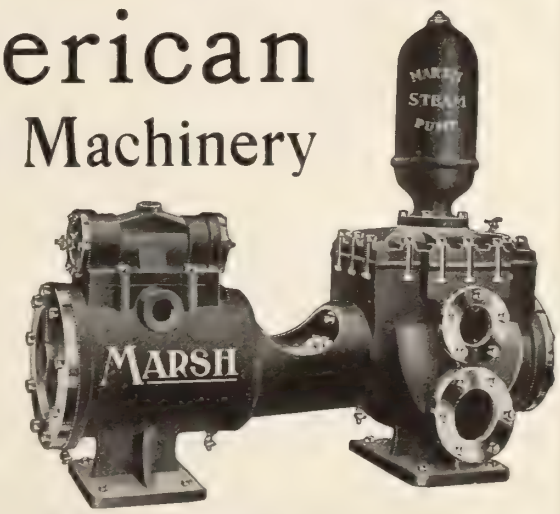
GUARANTEE: Every Marsh and American Pump is fully guaranteed to satisfactorily meet the service for which it is recommended.

BRONZE FITTINGS: Complete bronze fittings are part of the equipment of every pump.

SIMPLICITY: On the Marsh Pumps there is no outside valve motion while the steam valve with the exception of the steam piston itself is the only moving part on the steam end.

ECONOMY: Marsh and American Pumps are guaranteed to operate on about one third less steam than any duplex pump on the market. Only just enough steam is admitted to the steam cylinder to do the required work.

Our new 188 page No. 18 catalog contains a great deal of information about pumping machinery that will be of interest to you. Write to-day for your copy.



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CARELS DROP VALVE STEAM ENGINES

for HIGHEST ECONOMY and RELIABILITY

Sole Licensees for Great Britain and the Colonies

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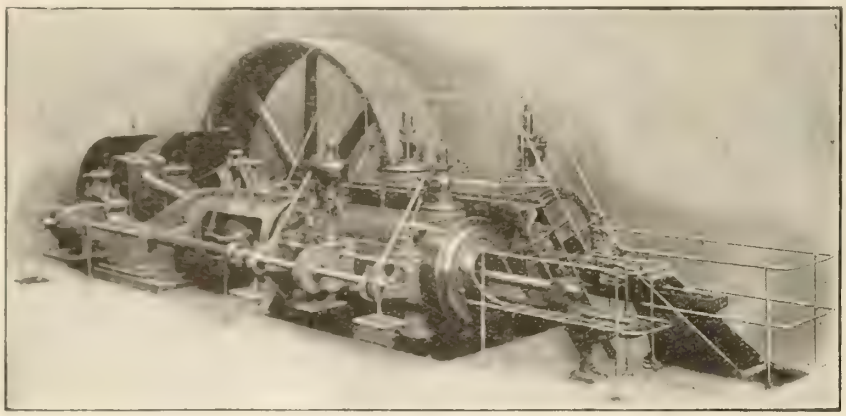

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STEAM and ELECTRIC HAULING and WINDING GEARS.

Large Pumps for WATERWORKS and MINES.

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In a class all by itself. Efficient—it cuts pipe and threads pipe with absolute accuracy. Economical—one man can do the work. The machine can be taken on the job. Power can be shut off when machine is not in use. It is the ideal machine for the modern plant.

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GAUGE GLASSES

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prove very interesting reading to every user of power. It gives you some rather startling facts about the cost of different kinds of power. It compares the cost of producing power by coal, by water, by electricity, by producer gas. The figures are correct, and actual tests are shown. The information it contains is worth knowing, so send for the little book to-day.

The Canada Producer & Gas Engine Co., Limited

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Do You Ever Have Hard Work In Locating Your Superintendent?

WITH NORTHERN ELECTRIC INTERPHONES you can get the Superintendent regardless of what part of your factory he happens to be in.

THE SUPERINTENDENT'S CALL EQUIPMENT can be furnished for sets installed in factories, stores, etc, to enable a general signal to be given throughout the whole system. Thus the superintendent, who may be in any one or another of the departments, can be called in a moment.

This requires but two extra conductors running throughout the system. a battery, one push-button from each station from which it is desired to send in a superintendent's call, and one call bell for each department outside his own in which the superintendent is liable to be engaged.

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Send for Bulletin 992 with full particulars of Northern Electric Interphones.

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Manufacturer and Supplier of all Apparatus and Equipment Used in the Construction, Operation and Maintenance of Telephone, Fire Alarm and Electric Railway Plants.

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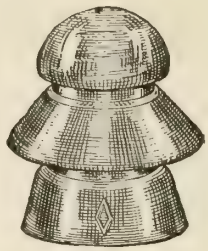

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WESTON ELECTRICAL MEASURING INSTRUMENTS

DRY BATTERIES

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"Chloride Accumulator"

REGISTERED SEPTEMBER 11, 1894

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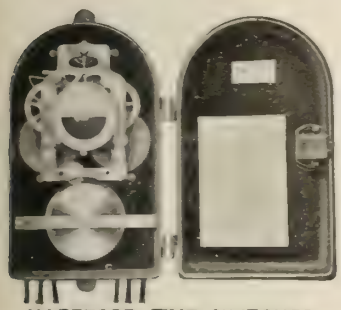

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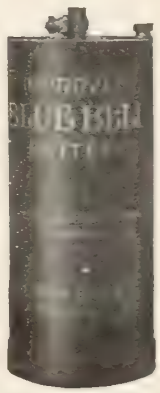

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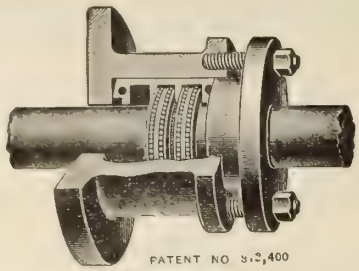

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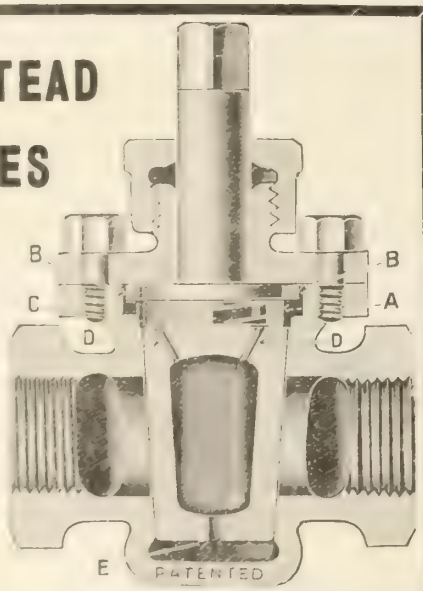

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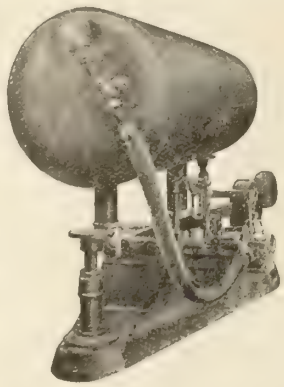

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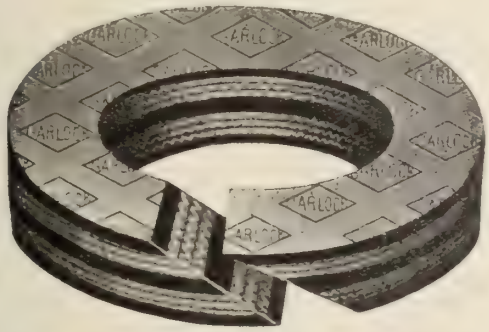

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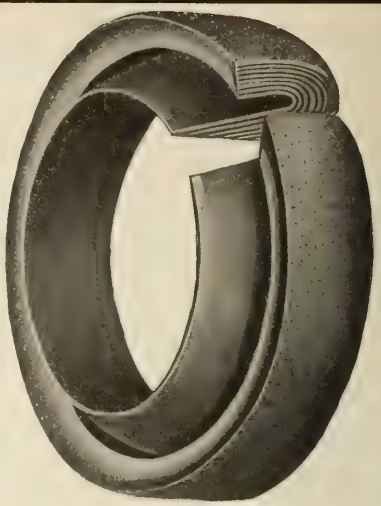

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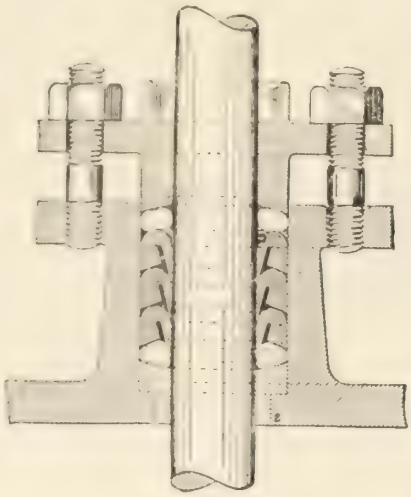

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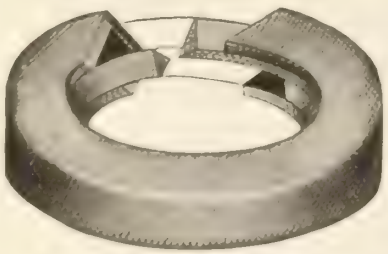

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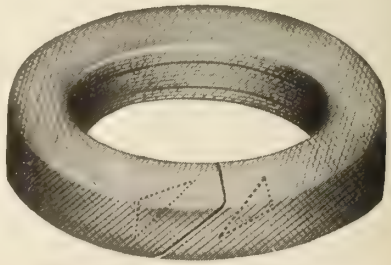

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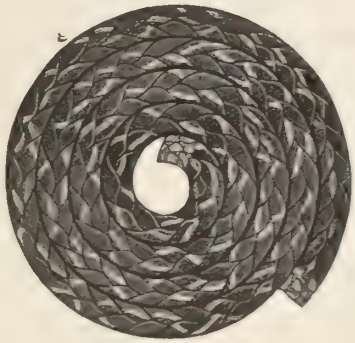

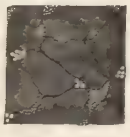

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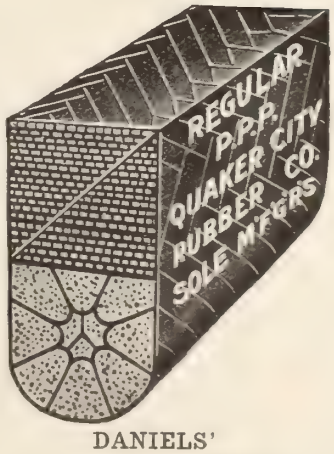

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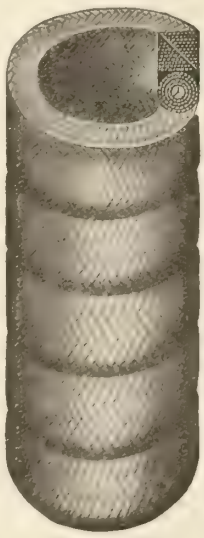

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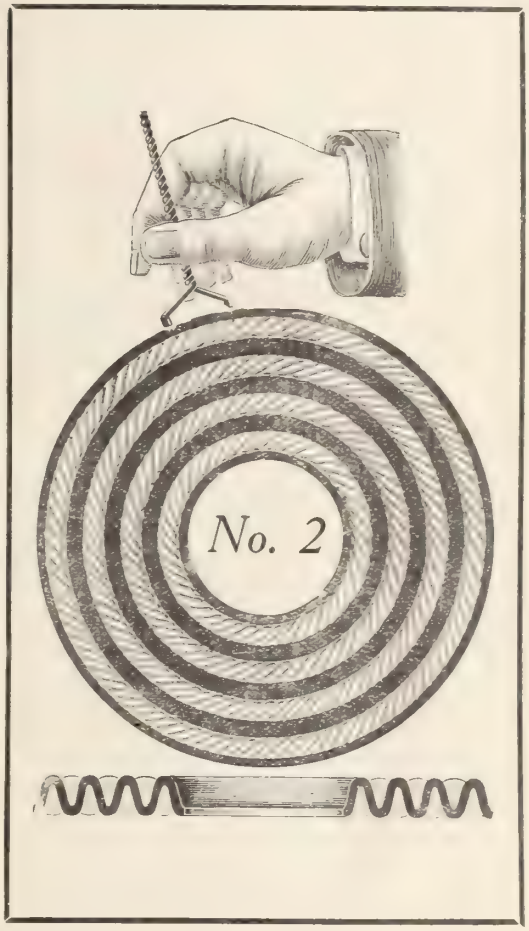

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Dunlop P.R.P. under pressure showing how it expands to take up wear from the rod.

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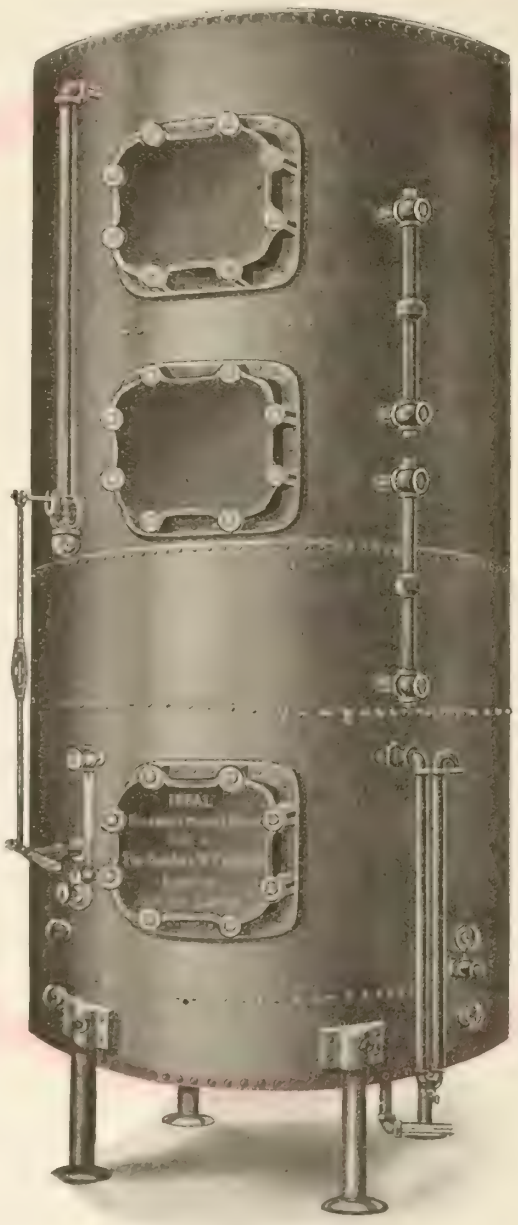

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Devices for the Removal of Oil from Boiler Feed Water

By J. A. Seager, Bristol, England

The Writer Discusses Briefly the Loss of Efficiency and Danger Attaching to the Presence of Oil in Steam Boiler Feed Water, and After Detailing Several Varieties of Mechanical Equipment to Secure Oil Elimination, Refers to the Fact That Chemical Treatment is Also Necessary if Absolute Purification is to be Obtained.

POWER house engineers need to keep a sharp eye on the quality of water going into their boilers. The science of water-softening now receives so much careful attention in modern installations that it is not proposed in these notes to refer to it, but rather to turn

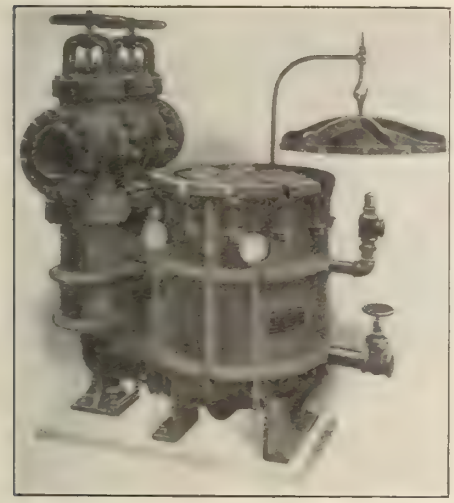


Fig. 1. "Blackburn-Smith" feed water filter and grease extractor.

attention to the necessity for careful treatment of the water, apart altogether from the lime salts which it may contain. We believe that in some quarters this latter necessity is not realized as fully as it might be, with the result that pitting and corrosion of boilers goes on insidiously. Putting it briefly, not enough attention is being paid to the elimination of oil from the feed water in cases where condensed steam is returned to the boilers.

The steam turbine is to some extent replacing the reciprocating engine, which means that less oil is used in the steam chambers, and in electric power houses, auxiliary machinery is often driven by electricity instead of steam. In spite of all this, however, oil is still a boiler-house trouble, and the apparatus, designed to combat it, is worth ome brief attention.

Greasy Surfaces Lower Boiler Efficiency.

Although the action of oil or grease in forming deposits which cause boiler plates to bag and tubes to burn out, and acidify the water to causing pitting, is well known, the loss of heat energy, by a boiler where oil-films are present, is not so generally recognized. As a matter of fact, however, the slightest trace of oil on a boiler plate reduces its heat-transmission efficiency enormously. Mr. A. J. Burston before the Institute of Naval Architects showed that the loss of efficiency of the heating surface of boiler tubes due to a thin coating of grease varied between eight and fifteen per cent. The effect of this on the coal-

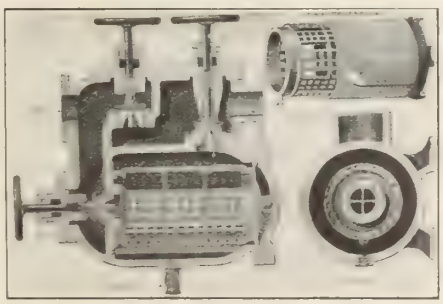


Fig. 3. "Rankine" feed water filter.

bill should alone be sufficient inducement to power engineers to use every endeavor to get rid of every trace of oil in the feed. It is not enough to get rid of the rich cakes of fatty matter that sometimes float out of the condenser; the thin film of oil that floats on the top of the hot well must also be removed.

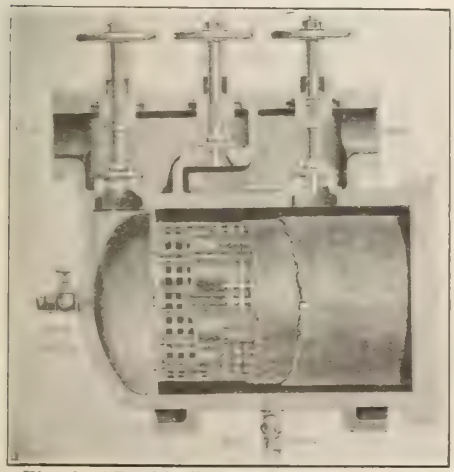


Fig. 4.—"Rankine" compound feed water filter

"Blackburn-Smith" Feed Water Filter and Grease Extractor.

An interesting type of feed water filter and grease extractor is the "Blackburn-Smith" made by J. Beggs & Co., New York. This is shown in Fig. 1, and consists of a filter chest divided by a partition into two chambers; the water entering through the inlet to the upper or filtering chamber and passing to the lower or outlet chamber through the filtering cartridges set in the partition, then through the outlet to the feed line. The water passes through these cartridges with little friction, but in the course of time as foreign matter accumulates on the filtering material, some resistance will result, and is shown by the readings of pressure gauges connected to the filtering and outlet chambers. A water relief valve automatically prevents the building up of excessive pressure in the pump discharge line. This filter has small convenient cartridges which compel double filtration through two separated and independent filtering surfaces,

Fig. 2.—"Blackburn-Smith" feed water filter cylinder.

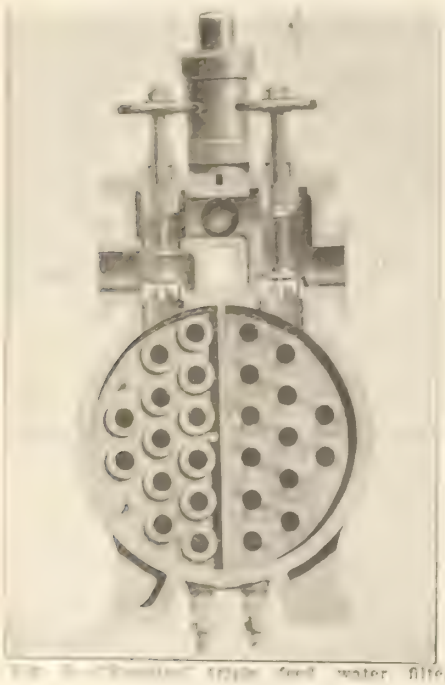
and the number of these cartridges varies with the size of the unit.

The filtering media can be changed quickly when foul and the heavier impurities which collect on the outer filtering cloth may be partially removed by reversing the flow, which is done without shutting down the plant. If sufficient impurities are not thus washed out of the filtering cloth to reduce the pressure difference as shown by the gauges, the filter should be cleaned by removing the foul and inserting the spare cylinders. Each foul cylinder may be removed in one operation and the spare clipped into the filter and capped as shown in the illustration Fig. 2.

The "Rankine" Feed Water Filter.

Another form of filter with cloth as the filtering medium, and extensively used in Great Britain, is that made by the Rankine Patent Feed Water Filter Co., Liverpool. This is shown in its simplest form in Fig. 3. It consists of an egg-ended cylindrical cast-iron or gun metal filtering chamber, formed on lines which give great strength together with compactness and efficiency. The valve chest and inlet branches are cast on the chamber, making the apparatus compact, and economizing space. Three valves, an inlet, outlet and bypass, are provided, the inlet and bypass lying lateral, and the outlet horizontal.

The internal arrangement consists of a cylindrical cartridge of phosphor bronze, made in the form of a grating, and is closed at one end by means of a turned cover, secured by screw bolts. The end is also turned up to fit the diaphragm seat at the base of the cartridge and the closed end is turned up to the mouth of the filtering chamber. This forms the cartridge proper. Two or more turns of filtering cloth are wound round the filtering cartridge, and secured at the ends with straps and buckles. A rubber buffer is fitted into the recess of the door of the filter, which compresses the closed end of the filtering cartridge, and holds it in place. A modification of this filter is also adapted for the separation of mud and sand from river water. Where the amount of feed to be dealt with is large, the filter is made multiple type; frames being made to receive from seven to nineteen cartridges in proportion to the indicated horse power.



The Sentinel triple feed water filter.

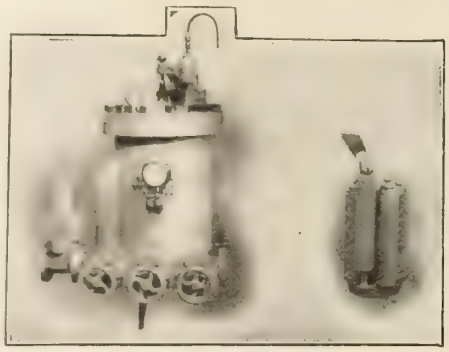


Fig. 6.—The "Sentinel" filter.

In dealing with very thin qualities of cylinder oil, considerable difficulty has been experienced, because a large quantity of the oil passes the first filtering stratum, whatever its material may be The makers, therefore, advocate extracting the oil by first filtering through the stratum, then separating or distributing the feed water over as great or greater filtering surface than the first, the object being to divide the flow and split it up, and, at the same time, by the increased area, prevent undue resistance being set-up on the first stratum and the feed pumps. By experience, they find that if this principle is adhered to, the second filtration will take up as much oil as the first, and all oil will be effectually extracted. With this object in view, the compound filter shown in Fig. 4 has been designed for electric lighting plants, mills and factories of all kinds. Rankine filters have been extensively used in the British Navy for triple filtration purposes, as shown in Fig. 5.

The "Sentinel" Filter.

There are numerous filters on much the same lines as the above, differing in detail such as the arrangement of the supports for the filtering material and the substance and make-up of the filtering fabric. For example, in the "Sentinel" filter made by Alley & McLellan, Glasgow, for pressures up to 200 lbs., and shown in Fig. 6, the filtering medium adopted is cocoanut fibre, which, while porous, seems to have an affinity for oil, and allows a surface area equal to 250 times the areas of the feed pipe.

To be continuously efficient, a filter must be cleaned regularly. In this design it is necessary only to unscrew the two bolts of the small cover and to swing this aside; then the revolving frame is turned like the barrel of a revolver, by a spanner placed on the square end of the spindle which extends through the cover, and the mantles lifted by the wooden handle provided on each, as shown.

Caird & Raymer Pressure Type Filter.

The pressure-type filter made by Caird & Rayner, Limehouse, London, consists of a cylindrical vessel with a double bottom into which is screwed a series of perforated brass carriers over which is placed the filtering materials. The water passes through the mantles into the double bottom and from thence to the boilers. Bypass valves are fitted to isolate the filter when changing the mantles, an operation which can be performed in a few minutes. The illustration, Fig. 7, shows the filter with the cover displaced for changing the mantles.

Harris Feed Water Filter.

Fig. 8 shows the Harris feed water filter, which is almost self-explanatory. A is the inlet, and B the outlet valve; C the by-pass valve, D the sludge valve, E the Board-of-Trade valve, and F the steam valve. The filter can be sludged, without opening out, by reversing the current of water, and this sludging action materially increases the time which

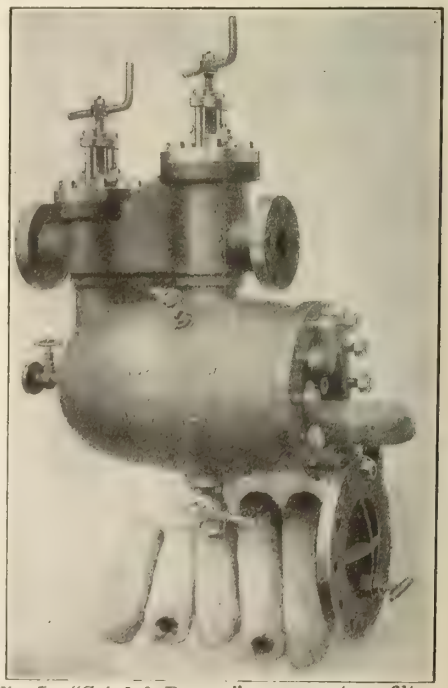


Fig. 7.—"Caird & Rayner" pressure type filter.

can be allowed before the filter has to be cleaned.

Carruthers Gravitation Filter.

The design of feed water filter, by J. H. Carruthers, Glasgow, and known as a Gravitation Filter, comes under List

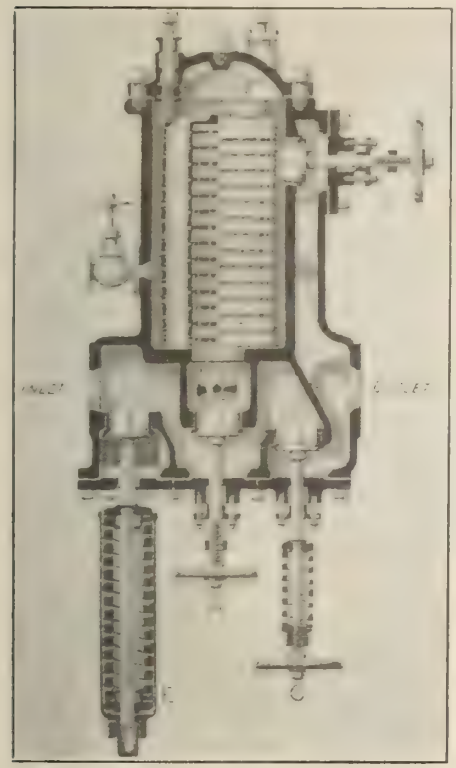


Fig. 8.—The "Harris" feed water filter.

& Munn's patents. In dealing with the filtration of feed water to separate the oil or grease, this firm works on the principle that it is necessary to have a slow rate of flow through the filtering medium, so that the oil may have time to deposit upon the cloth. This necessitates a large filtering surface and a low pressure for propelling the water, in fact, a vertical head of 6 or 8 feet is all that is required. The filters are made either of the single tank or twin type. In addition to its action as a grease extractor, this filter is arranged to eliminate a large proportion of the air in the feed water, and this very valuable property has great effect in preserving the boilers from corrosion. There are two strata of filtering medium, and the apparatus is usually placed between the air pump and the feed tank, a suitable uprising pipe or vessel being provided on the hot well to give the necessary head. This design is in use by many of the principal steamship lines of Great Britain. Fig. 9 shows the general arrangement of a twin filter.

Mather & Platt Filter.

Of a rather different type of construction is the type of filter manufacturered by Mather & Platt, Ltd., Manchester. As will be seen from the section in Fig. 10, this filter consists of a closed vertical cylindrical chamber of cast iron, which is fitted inside with an outer open-ended perforated steel cylinder and an inner perforated steel tube connected direct to the outlet valve on the top. Both the perforated cylinder and the perforated tube are covered with wire gauze and with very finely perforated sheets of muntz metal, so as to prevent the possibility of escape of any of the filtering medium. This latter consists of coarsely granulated soft-wood sawdust, which is tightly packed into the annular space between the outer steel cylinder and the inner steel tube until this space is completely filled up. The feed water on its way to the boiler, percolates slowly through the sawdust, which absorbs the oil. When at work, the entering water impinges first on a baffle plate, and then passes into the annular space outside the outer perforated cylinder, where it permeates the sawdust,

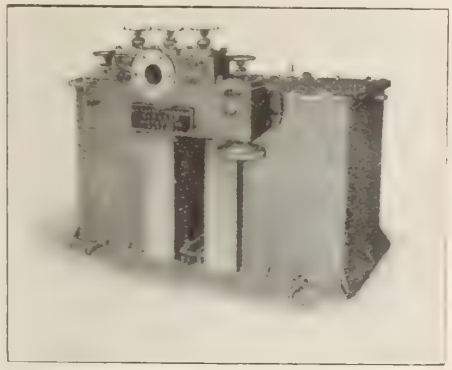


Fig. 9.—"Carruthers" gravitation twin filter.

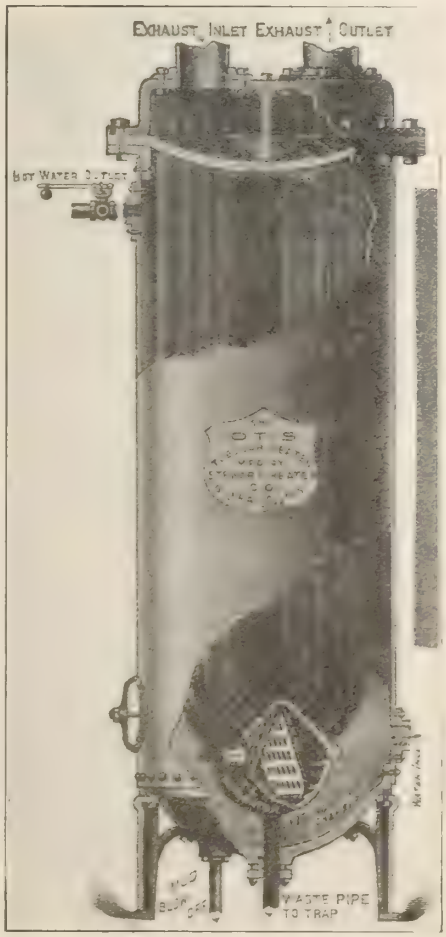


Fig. 11.—The "Otis" tubular heater.

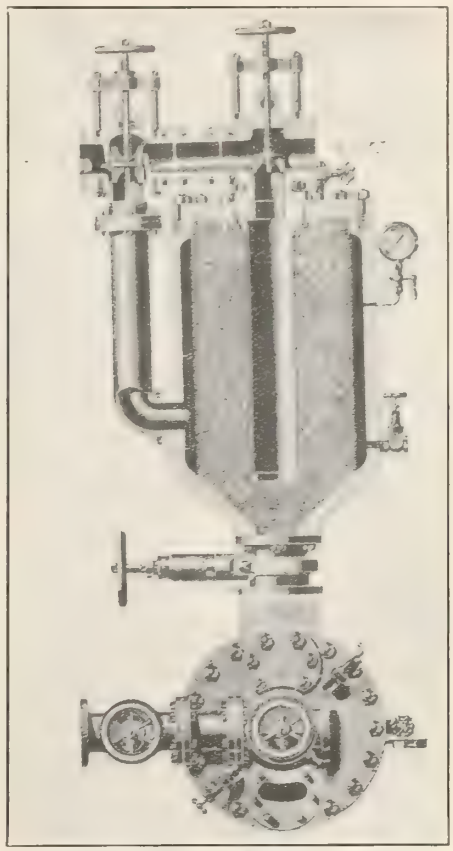


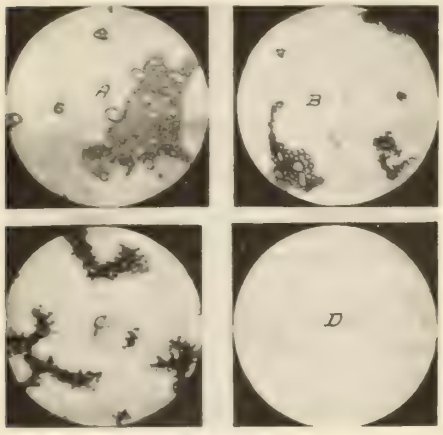
Fig. 10.—"Mather & Platt" Filter.

and gathers in the inner perforated tube, thence passing to the outlet valve. So long as the filter is working properly the pressure gauge will show only the pressure due to the steam in the boiler, but as the sawdust becomes gradually clogged with oil and other impurities the pressure will increase, and the sawdust should then be changed.

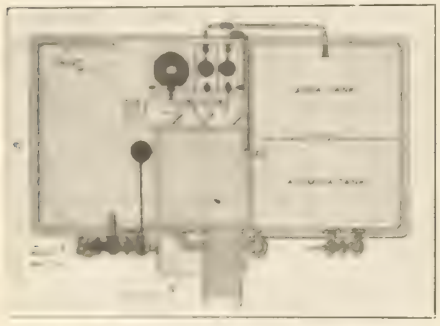
The Otis Tubular Heater.

Although, generally speaking, devices which try to combine several different functions in one unit, are not to be recommended, there is a most ingenious feed water heater, oil separator and purifier known as the "Otis Tubular Heater," which uses either live or exhaust steam, deposits suspended matter, and provides for the disposition of oil which has been carried with the steam. This combined apparatus, made by the Stewart Heater Co., Buffalo, N.Y., has been largely installed in connection with condensing engines and also for the heating of buildings; the exhaust steam in the latter case passing from the feed heater to the steam radiators. The construction of the vertical type is shown in Fig. 11. It will be noticed that the exhaust steam enters and leaves the

heater at the top, this being done to provide an oil separator and cool settling chamber in the bottom for the sediment below and away from the tubes, where it remains as soft mud until removed. As the tubes are suspended from the top they are at liberty to contract and expend freely, and they do not therefore become loose by reason of con-



traction and expansion. Particular attention may be drawn to the oil separator, connected at the lower end of the tubes, which separates the water of condensation and the oil carried over with the exhaust steam, and makes it practic-



able to use the latter, after passing through the heater, for heating buildings, etc., with return of condensation to the boilers without extra expense.

Chemical Treatment Also Necessary.

Up till now, purely mechanical methods of oil separation have been considered. With the high steam pressures now so common in power houses, and the consequent high temperatures at which lubricating oil mingles with the steam, it is acknowledged to be impossible to remove all oil from exhaust steam by any form of mechanical separator in the exhaust main, and equally useless to try to entirely remove it after condensation by mechanical filtration. The high rate at which exhaust steam passes to the condenser tends to make difficult to discriminate between oil vapor and water vapor. Moreover, in the very performance of their duty, these separators become coated with oil and cannot be expected to discharge pure steam for long without careful attention. It has become recognized that chemical treatment of the minute particles of oil, carried in water from high pressure steam, is necessary in order to coagulate and render them susceptible to mechanical filtration. Without this, oil will pass through the finest filter made.

Paterson Oil Eliminator.

Microscopic examination shows that oil globules, some of which do not exceed 1-100,000 of an inch diameter, are clustered together in groups not unlike "fish roe." They can be clearly seen in photomicro A, Fig. 12. Photomicro B shows the oily globules present in water after mechanical filtration. Their presence can only be accounted for by the fact that the globules are elastic and will squeeze through an infinitessimally small orifice and reform again. Photomicro C shows the result of the treatment given in the oil eliminator made by the Paterson Engineering Co., London. It will be noted that the "fish roe" appearance has given place to that of a fine feathery and moss-like condition. Photomicro D is a sample of water as finally discharged from the Paterson purifier, and reveals no trace of oil. The eliminator is shown in Fig. 13.

The greasy condensed steam enters the measuring chamber quietly and overflows through the vertical discharge slit, which is made long and narrow so as to produce a maximum rise and fall in the water level. The weir in this way is made very sensitive to the amount of water passing, and the quantity flowing through is known by the height. A large float controls the position of two long valves in adjoining compartments, giving annular orifices which discharge the weight of re-agents in accurate proportion to the amount of water passing through the weir. The greasy water and the re-agents are thoroughly mixed by baffles in a horizontal mixing trough before passing into the re-action and precipitating tank. Here the black oil, if any, floats to the surface in the form of thick sludge, and can be overflowed to the drain. The bulk of the coagulated impurities is arrested by filtering upwards through wood fibre, the final purification taking place in the quartz sand filter. The filtered water is drawn off by a large number of gun-metal strainers having renewable phosphor bronze screens. The wood fibre strainer re-

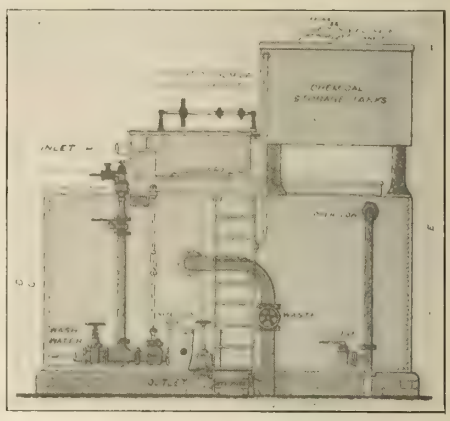


Fig. 13. "Paterson" oil eliminator.

moves practically the whole of the oil when the plant is first started, but after operating for some time, the meshes become foul. This increases the velocity of flow, and tends to carry the impurities forward. To make it impos-

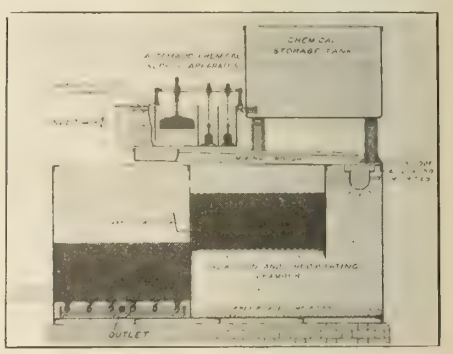
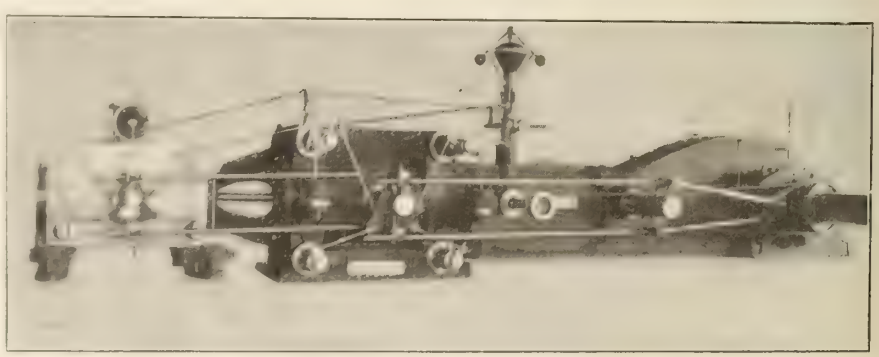


Fig. 13. "Paterson" oil eliminator.

sible for these to reach the boiler, a quartz sand filter is fitted.

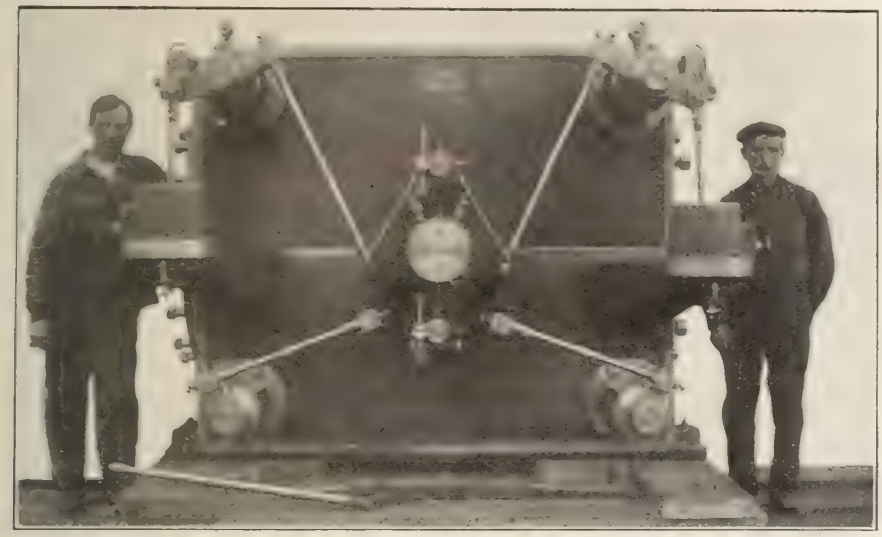
General Observations.

It will be realized that the above notes cover only a portion of a very



Leonard heavy duty tandem-compound engine.

important phase of power-house engineering. The treatment of feed-water is by no means confined to the elimination of oil. Where water is drawn from rivers, mechanical straining is necessary to abstract sand, mud, and foreign substances such as weed. Well water, again, highly impregnated with calcium salts, requires hot or cold chemical softeners. In some cases, acidity has to be corrected, while instances are not wanting where peat and iron salt have to be eliminated. To deal with all these points, an extensive investigation of each particular plant conditions would have to be made.



L. P. Cylinder Leonard heavy duty tandem-compound engine.

HEAVY DUTY TANDEM COMPOUND CORLISS ENGINES.

E. Leonard & Sons, London, Ont., have recently completed for the St. Lawrence Pressed Brick Co., Laprairie, Que., a large heavy duty tandem compound Corliss engine, designed to develop about 750 I.H.P. The cylinders are 18 and 34 inches diameter by 42 inches stroke, and the shaft is fitted with a double armed pulley, 16 feet diameter by 48 inches face.

Fig. 1 shows a general view of the engine as it lay in the shop previous to shipment, while fig. 2 shows the low-pressure cylinder.

STEAM AND GAS ENGINES IN NEW ZEALAND.

The annual report for 1910-11 of the inspector of machinery in New Zealand, states that gas and oil engines appear to be displacing steam apparatus, except where steam is required for manufacturing purposes. Most of these engines are imported. Certificates of inspection were issued during the year for 6,212 boilers, 3,206 gas and oil engines, 238 Pelton motors, and 1,474 other water engines. The total of new boilers added to the inspection books during the year amounted to 543, of which 160 were imported and 383 were constructed locally.

In the same degree in which a man's mind is nearer to freedom from all passion, in the same degree also is it nearer to strength.—Marcus Antoninus.

It is well for a man to respect his own vocation, whatever it is; to think himself bound to uphold it, and to claim for it the respect it deserves.—Little Dorrit.

Marine Boiler Firing Regulations on the Chicago River*

By C. T. R.

Notwithstanding the Fact That the Contents of This Article Apply Primarily to Marine Boiler Operation, so as to Reduce the Emission of Dense Black Smoke to a Minimum, Men in Charge of Stationary Steam Power Plants Will Find the Information and Illustrations Valuable and Instructive, and Equally Effective of Application to the Boilers Under Their Care, if They Would Secure the Best Possible Results.

THE following instructions for firing a vessel without making dense smoke while in the Chicago River and harbor apply to the average freight and passenger boat. While the advice is given as specifically as possible, yet there are instances when a little deviation might bring better results. What may apply on one boat might not apply on others, but the instructions are so general that freight and passenger boats having either Scotch marine or fire box boilers, can use them to advantage in the effort to eliminate dense smoke.

Coming Into Port.

Clean fires before reaching Chicago. Before entering the harbor, shove fuel to rear of grates, clearing about two feet of front grate surface; cover burning fuel with about four inches of fresh coal and fill cleared space with broken coal almost to top of furnace; leave door cracked for short interval and put on blower. Have all fires in the condition shown in Fig. 1 when abreast the Life Saving Station; the vessel will then be able to reach her dock without again working the fires. All further firing while in the Chicago River should be with Pocahontas coal.

Firing at the Dock.

When steam is required, or fire on rear of grate gets low, push coked coal back, and quickly charge front of furnace with fresh coal as before. Leave door cracked for short time and keep blower on, until top of fire assumes bright red color. Regulate steam by damper. Fig. 2 illustrates condition of fire before pushing back.

Cleaning Fires in Port.

Avoid, when possible, the cleaning of fires in port. If necessary to do so, clean quickly, and when convenient only one boiler during an hour. Throw broken coal in front wings of furnace on each side for a distance of three or four feet, crack door and use blower, then wait until the last charge of coal is burning well, and close ash-pit door. Rake out in front all the old fuel on the central portion of grate and fill cleared space with well broken-up coal to a thickness of four or five inches. If steam is not required, let green fuel catch, and get

*Issued by the Department of Smoke Inspection, Chicago, September, 1911.

well coked from the live beds at the sides.

To raise steam more quickly, the burning fuel at the sides can be winged-over on top of the green coal. After either operation, open the ash-pit door and put on blower until fire gets action. After the middle portion has ignited well, rake out the sides, which will be nearly burned out; charge with fresh, broken-up coal, and allow this to burn without winging over the centre. Crack doors and use blower. Fig. 5 shows condition of fire when cleaning by this method. Give plenty of time for fresh coal to coke before again disturbing fires. Do all cleaning and charging as quickly as possible, in order to preserve furnace temperature.

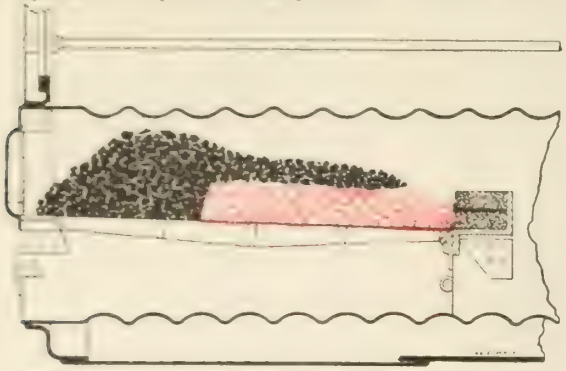


Figure 1—Fires in Condition to Enter Chicago Harbor.

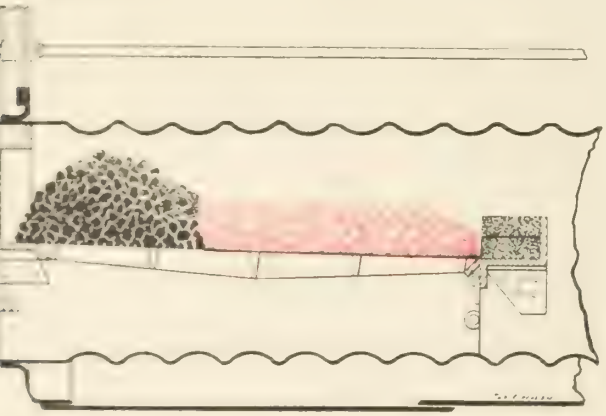


Figure 2—Fire Ready to Push Back.

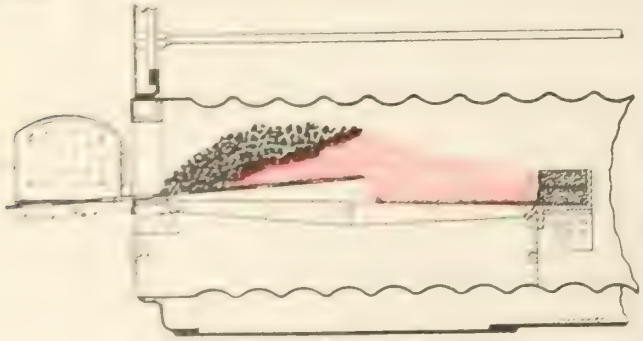


Figure 4—Method of Barring Fires.

To Fire While Shifting in River.

A half hour's notice or more should be given the fireman before getting under way, in order to have steam enough to shift without forcing fires. Raise steam by stirring top part of fire with rake and breaking up coked portion of fuel bed; crack door and use blower. Allow fire to burn brightly for a few minutes, push back and put new charge on front of grate, and repeat as often as necessary to hold steam. To make additional steam in shifting, fuel beds may be barred if necessary, but this should consist only of a slight raising of the bed and not passing the bar up through it, as clinkers will mix with the fuel, spoiling the fire and making smoke. See Fig. 4.

Lumps of fuel charged should never be larger than one's fist. Cracking of doors consists in doors being opened not over one inch, and as they are opened for short periods of time only, the flues will not be effected. While in the river, fires must be carried very thick at all times. If fires are allowed to burn down to three or four inches at the dock, it will be impossible to make steam without making smoke.

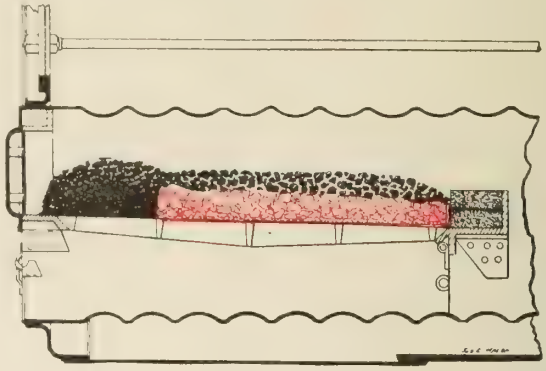


Figure 3—Showing Fire After Coked Coal Has Been Pushed Back.

Starting Fires.

Cover bare grate with well broken-up coal to an average thickness of about four inches; then put five scoops of live coal on top at bridge wall as shown in Fig. 6, and close fire door, with damper open. The fire will burn from back to front with much less smoke by this method than by any other. When the fire has covered entire grate, push fuel bed toward rear, and fill front of grate with fresh coal to about one-half the height of the furnace. This should be left undisturbed until mostly coked. Crack door and use blower, then shove coked coal back and repeat operation as often as necessary to raise steam. In all operations where fire is disturbed, give it a little air through doors and use blower. Flues should never be blown in the Chicago River.

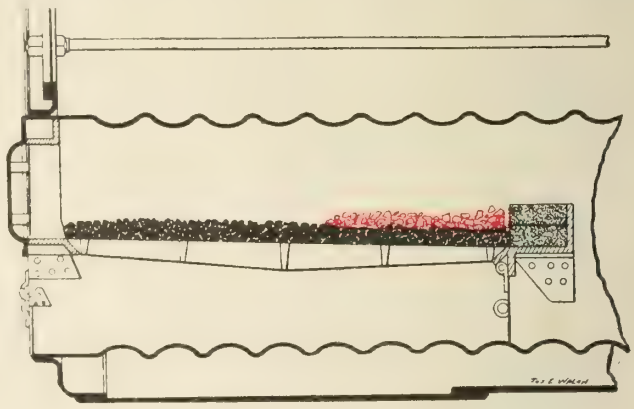


Figure 6—Method of Starting Fires.

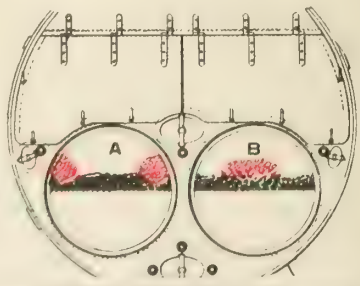


Figure 5—A. Central Portion of Grate After Being Cleaned Out and Charged With Fresh Coal.

B. Wings of Furnace Cleaned and Charged With Fresh Coal After Central Portion of Fuel Bed has Ignited.

Feed Water Heaters*

By D. K. Dean.**

THERE are presented here the results of chemical analyses of two samples of water. Sample No. 1 is that of feed water which would be classed as bad, and tables A and B give the results respectively, of a chemical analysis before and after passing through open heaters of well-known manufacture. Sample No. 2 is that of fairly good feed water, and tables C and D show, respectively, the results of its chemical analysis under like conditions.

Sample No. 1.—Table A.

	Grains per U.S. Gallon.
Volatile and organic matter	2.70
Silica	0.45
Iron and alumina oxides	0.20
Calcium carbonate	15.50
Calcium sulphate	0.71
Magnesium sulphate	12.69
Magnesium chloride	1.44
Magnesium Nitrate	0.27
Sodium chloride	7.12
Total solids	41.08
Suspended matter	5.85
Free carbonic acid	0.86
Incrusting solids	33.96
Non-incrusting solids	7.12

Sample No. 1.—Table B.

	Grains per U.S. Gallon.
Volatile and organic matter	2.30
Silica	0.45
Iron and alumina oxides	0.20
Calcium carbonate	7.30
Calcium sulphate	0.70
Magnesium sulphate	11.48
Magnesium chloride	1.40
Magnesium nitrate	0.12
Sodium chloride	6.20
Total solids	30.15
Suspended matter	9.86
Free carbonic acid	0.22
Incrusting solids	23.95
Non-incrusting solids	6.20

Sample No. 2.—Table C.

	Grains per U.S. Gallon.
Volatile and organic matter	2.73
Silica	0.75
Iron and alumina oxides	0.50
Calcium carbonate	3.51
Calcium sulphate	0.54
Magnesium sulphate	2.52
Sodium chloride	0.81
Total solids	11.36
Free carbonic acid	1.00
Incrusting solids	10.55
Non-incrusting solids	0.81

Sample No. 2.—Table D.

	Grains per U.S. Gallon.
Volatile and organic matter	3.56
Silica	0.65
Iron and alumina oxides	0.45
Calcium carbonate	2.65
Calcium sulphate	0.52
Magnesium sulphate	2.11
Sodium chloride	0.72
Total solids	10.66
Free carbonic acid	0.10
Incrusting solids	0.94
Non-incrusting solids	0.72

If these results be traced through, it will be found that practically all the impurities present in C sample No. 2, are to be found in the water after passing through the heater, either in the same or in different chemical combinations, with the exception of calcium and magnesium carbonates. Account, of course, must be taken of the fact that the feed water is diluted by the condensed water necessary to do the required heating in its passage through the heater.

The "Wainwright" heater—Makers, The Alberger Condenser Co., N.Y.—Agents, The Canadian Fairbanks Co.

Comparison of Results.

By comparing the two results, it will be observable that the greater the amount in solution, the greater the percentage of removal effected. It is evident that when purification by heat is attempted, there is proportionately less accomplished with waters low in scale-forming matter than with those waters containing a large amount. It will also be noted in the second set of analyses that the percentage of volatile and organic matter increased instead of decreased. This fact is to be accounted for only by the fact that oil was introduced into the feed water.

If it were permissible to generalize from the above, sample No. 1 would indicate, that with bad water, the temporary hardness (calcium and magnesium carbonates) might be reduced from 45 per cent. to 50 per cent. with but little reduction in the other impurities by passing through an open heater. Sample No. 2 would indicate that the temporary hardness might be reduced from 12 per cent. to 20 per cent. with fairly good water containing a moderate lime content.

It will be evident then, that the function of an exhaust steam feed water heater is not primarily that of a purifier; that where other impurities than calcium and magnesium carbonates are present, practically no reduction of the content of the former can be effected by the heater; that even if the content be largely of "temporary hardness," it would be well to depend upon some other purification system rather than upon the exhaust steam feed water heater, open or closed, if the plant in question were of sufficient size to make the expenditure for such a device profitable.

Pumping Water With the Closed Type Heater.

With the closed type of heater, pumping the feed water is a simple problem. The heater is placed between the pump and the boiler, and the water is pumped directly through the heater with one pump. The latter, therefore, handles only cold water and may be placed anywhere with reference to the former. The pumping head is the boiler pressure plus the friction in the piping and heater plus the suction head. The last, oftentimes, is positive, since the water supply is frequently taken from a city supply main or from a roof tank, consequently the total pumping head is frequently less than boiler pressure.

Pumping Water With the Open Type Heater.

With the open type of heater, two pumps or their equivalent are required to deliver the water to the boiler. One pump is required to deliver the water to the heater, and the second or feed pump is required to pump it away from the heater into the boiler. The head developed by the delivery pump is lost in the delivery valve of the heater and is of no assistance to the feed pump, hence

*Continuation of Paper read at the C.A.S.E. Convention, Stratford, Ont., July, 1911.
**Of the Alberger Condenser Co., New York.

the pumping of feed water with an open heater cannot be accomplished as economically as with a closed heater. With an open heater, also, the feed pump is required to handle hot water. The former, therefore, must be placed at a level sufficiently high above the feed pump that the hot water will not flash into steam in being drawn through the suction valves of the pump. It is quite necessary in selecting a pump to handle hot water, that it be of sufficiently large size that the piston speed will not be so high as to lower the pressure in the suction chamber, so that the water will vaporize and "pound".

Operation and Attention.

The correct operation of an open heater is so dependent upon its accessory devices that necessarily close attention must be paid to their condition. The oil separator must be of sufficient size to perform its functions, and constant attention should be paid to its drain line and trap to provide against its clogging, or as in some types of open heaters, to forestall the possibility of the oil, which had accumulated in the trap, backing up into the body of the heater, whenever the level of the water in storage rises above the overflow opening. Since most open heaters are of rectangular section, and consequently are able to withstand light pressures only, it is necessary that the possibility of a back pressure valve sticking be guarded against, otherwise a very serious blow-up may result.

The closed heater is self contained. Its correct operation is dependent only upon the action of the feed pump. If installed properly, the attention required would be a minimum.

The Heater—Shall It Be Open or Closed?

In choosing between the two types of heaters for a given installation, it is desirable to consider not only the characteristic of the types as outlined above, but also the kind of attention that the apparatus is to receive when installed. Probably the chief factor that determines which of the two types is better adaptable to a given situation, is the quality of the feed water. As has been indicated, "temporary hardness" consisting of carbonates of calcium and magnesium are the only impurities which can be removed at the temperature of the exhaust steam feed water heater. Hence no matter what impurities may be in the feed water, only the presence or absence of "temporary hardness" would have influence in determining the proper choice.

Good practice in the selection of one type or the other for conditions of feed waters is indicated as follows:

Notation. -(a) containing less than 10 grains of calcium and magnesium carbonates per U.S. gallon.

(b) containing more than 10 grains of calcium and magnesium carbonates per U.S. gallon.

Case I.—Non-Condensing plant, no heating system or industrial process requiring exhaust steam. A water works or isolated electric light plant is an example of this class.

(a) If the feed water contains less than 10 grains of "temporary hardness" the closed heater is unquestionably the type which should be selected. The freedom from oil contamination, the ease in pumping and regulation, and the economy in pumping would overweigh all advantages peculiar to the open type.

(b) If the feed water contains more than 10 grains of "temporary hardness" in small plants (less than 500 h.p.) the open type of heater should be selected, because of the fact that it can be depended upon to precipitate some of these impurities. For plants of 500 h.p. or over, it would usually pay to install a separate purification plant, especially if the water should contain impurities other than calcium and magnesium carbonates. In this case it would be advisable to install the closed type of heater in connection with the purification plant.

CASE II.—Non-condensing plant with industrial process requiring steam greatly in excess of the amount exhausted from the generating units. Example.—Paper mill. In such a plant it would be advisable, of course, to save the returns from the plant system. While the open heater would offer the advantage of a large storage space for the collection of such drips, it would be unwise to contaminate such drips with oily exhaust. A closed type of heater would be the best for this case, the drips being collected in separate hot well. This low pressure heater, as it is called, has a large storage space for the collection of pure drips, and the water is heated by passing through tubing, which separates it from the exhaust steam of the auxiliaries.

CASE III.—Non-condensing plant, steam used in heating system. For such a plant, since the heating system is in operation only about four months every year, the choice depends chiefly upon the factors influencing the selection of a heater under Case I.

CASE IV.—Reciprocating engine plant running surface condensing—condensation used as boiler feed. In such a plant the main body of feed water must be purified of oil, and as a consequence, the addition of the extra amount held in suspension by the steam required for heating in an open heater would only make necessary the provision of extra large oil filtering devices. The open heater, here, would probably be preferable to the closed, since it offers a simple method of saving steam required for feed water heating.

A marine plant is a special type of this class. The closed type of feed water heater only can be used, since the rolling of the ship would not permit the use of the open commercial type. Furthermore, the latter type would be too bulky for use on shipboard.

CASE V.—Reciprocating engine or turbine plant, jet or surface condensing—condensation not returned to the boiler. For such a plant, the choice of one or the other type of heater would depend mainly upon the character of the feed water as in Case I. The closed type is generally adopted.

The Vacuum or Primary Heater.

In some special cases, with condensing plants, it may be advantageous to place the heater between the main generating unit and the condenser, in order to raise the temperature of the feed water from that of the source of supply to that corresponding to the vacuum carried, and thereby effect a saving. Such a heater must necessarily be of the closed type. The primary heater is generally applicable, and will show a saving with a jet condensing plant, and in some surface condensing plants where the condensation is not returned to the boiler. With a modern surface condenser, particularly of the type in which the steam enters at the bottom of the shell, and flows upwards through the body towards the dry vacuum pump connection, the temperature of the condensation is virtually that of the vacuum. The use of a primary heater in such a plant would not increase the economy appreciably.

A water works is a type of surface condensing plant in which a primary heater will show considerable economy. Here, the condensation is wasted because of the difficulty in removing the oil introduced into the steam in its passage through the cylinder. A primary heater placed in the exhaust line, between the steam cylinder and the condenser, will raise the temperature of the raw feed water to approximately that corresponding to the vacuum carried.

CASE VI.—Turbine plant, surface condensing—condensation used for boiler feed—reciprocating auxiliaries. In such a plant, it manifestly would be

unwise to contaminate the pure water of condensation with the oil in the steam exhausted from auxiliaries. The closed type of heater therefore would be the proper choice.

CASE VII.—Turbine plant, surface condensing—condensation used for boiler feed—all auxiliaries steam turbine driven. In such a plant, there would be no possibility of oil contamination with steam from the auxiliaries. Hence the open type of heater would offer more advantages than the closed type.

MARSH BOILER FEED PUMP.

IN the "Marsh" boiler feed pumps, there is no outside valve gear, the actuation being accomplished by a perfectly balanced valve traveling in the steam chest. This valve, with the exception of the steam piston itself, is the only moving part on the steam end. There are no tappets to become worn or broken. The steam valve is so arranged that just enough steam is admitted to the cylinder to do the required work. The regulation is not only automatic but instantaneous and even should the suction be suddenly broken off, the pump will not race or pound. Moreover, it insures the highest economy in steam consumption under all conditions.

The type of valve mechanism offers many advantages. It is impossible for the pump to short stroke, and since that is so, clearance may be reduced to a minimum, which means increased economy, a maximum suction lift and delivery of the full water cylinder capacity. Every pump is designed to perform a certain service, and the best grade of material and workmanship are used in their construction. The piston rod, glands, gland nuts, and stuffing boxes are of bronze. The water cylinder is regularly fitted with a bronze lining, held in place by studs, so that it may easily be turned or taken out for reboring. The valves and water ways are of ample size and the valves are of material to suit the service required. The valve mechanism, which as before stated, consists only of two parts (chest and valve), is practically the only part of the pump which will show wear, and when, after long service, there is evidence of such, a new steam chest furnishes to all intents and purposes a new pump. The pumps are all tested before leaving the factory and workmanship and material are guaranteed.

STEAM AND GAS ENGINES.

In his report for 1910 Mr. Michael Longridge, the chief engineer of the British Engine, Boiler and Electrical Insurance Company (Limited), states that the proportion of gas to steam engines insured has continued to increase, and that, while in 1908 the proportion was 27 steam to 20 gas engines, in 1909 the figures were 26 to 20, and in 1910 they were 25 to 20. The gas engines insured are slowly increasing in size and power, but they are still far behind steam apparatus in these respects. In 1909 the rates of breakdown among insured steam and gas engines were 1 in 10.2 and 1 in 10.4, as compared with 1 in 9.7 and 1 in 10.8 respectively in 1910. In an analysis of the parts of steam engines which are believed to have given way first in various failures which occurred last year, 26.6 per cent. are attributed to valves and valve gear, followed by air pump motions, 10.3 per cent., spur gearing, 8.9 per cent., and air pump buckets and valves, 8 per cent. With regard to gas and oil engines, the parts believed to have failed first were valves and gear, 42.8 per cent.; connecting rods and their bolts, 9.1 per cent.; cylinders and cylinder ends, 8.5 per cent.; and main shafts, 7.9 per cent.

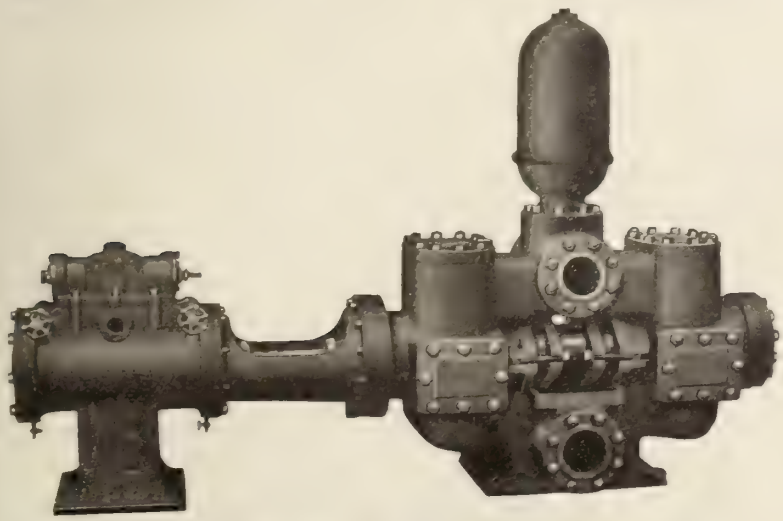
CUTTING DOWN BACK PRESSURE INCREASES POWER.

It seems hard to realize, that even today, many manufacturers are throwing away their exhaust steam instead of utilizing it for heating or manufacturing purposes. Further, cases have often arisen, where a manufacturer needed more power to meet an increase of factory production, and immediately purchased a new engine, whereas, the old one might have been made to do the work if its back pressure had been cut down.

A steam heating concern recently inspected a manufacturing plant, where an increase of power was desired, as the factory output had somewhat increased. The manufacturers had almost decided to instal a new engine, but after having carefully considered the report of the engineers, concluded to put in a Vacuum System. With this vacuum system, the back pressure was reduced sufficiently to enable the engine to perform the increased work. Further, it effected steam circulation in a few minutes from the time of being turned on, while with the old system, it took hours. It would not surprise us to find that many manufacturers, alive to all the advantages of scientific management, are totally overlooking the saving and comfort that could be secured by using a vacuum system in connection with the exhaust of their engines.

1912 MASTER BOILER MAKERS' ASSOCIATION CONVENTION.

At a meeting of the executive committee of the Master Boiler Maker's Association, held at the Fort-Pitt Hotel, Pittsburgh, Saturday, Oct. 28th, it was unanimously decided to hold the Sixth Annual Convention of this association in Pittsburgh, May 14th to 17th inclusive, 1912—Headquarters the Fort-Pitt Hotel. George N. Riley, of the National Tube Company, was made chairman of the General Committee of Arrangements, and Roger T. Flannery, of the Flannery Bolt Company, secretary.



Marsh Boiler Feed Pump

Marsh Boiler Feed Pump.

Record of Injector Troubles that Have Been Overcome

By Frank J. O'Leary *

The Writer, in Dealing With Various Injector Troubles That Have Called for His Assistance in Solving, Voices a Number of Hints Which Will Prevent Their Occurrence to a Great Extent, and Suggests Causes and Remedies, Should They Appear.

AS compared with the length of time that the majority of other accessories have been used in the handling and generation of steam, the injector is of so recent origin that the principle upon which it operates has not until lately been fully understood by all classes of steam engineers.

Development of injectors began with their application to steam boilers of railroad locomotive engines, in which service there has always existed a standard method of attaching them. If a lifting injector is used, it is located in or near the cab slightly above the high water level of the tender. This being the adopted location of the injectors for nearly all locomotives, it simplifies the work necessary to produce an efficient injector, because each injector is required to work under exactly the same conditions.

In the application of the injector to general stationary boiler service, it must work under many different conditions. Sometimes it is required to lift its supply from very deep sources, while at other times, its supply is above the injector. Hot water supply and great variation of steam pressures, also, are conditions met with by injectors used on boilers in manufacturing plants and on traction engines used in agriculture. On account of these it is more difficult to produce a generally efficient injector for stationary boiler service than it is to produce one for the more uniform requirements of railroads.

Injectors of the automatic type lend themselves more efficiently to the various conditions of service of stationary and agricultural boilers, but many conditions exist which make it necessary for the manufacturers of the stationary boiler injector to specialize for some extreme conditions. To make an injector capable of fulfilling the requirements of certain cases, a study of the location of the water supply is necessary, so that advantage may be taken to arrange the piping to aid its working. Such study falls usually upon the injector expert for the company manufacturing, and since many times in my experience I have overcome difficulties with injectors, I believe that a relation of some of these experiences, illustrated with piping plans, will be of help to engineers.

*Mechanical expert, The Penberthy Injector Company.

High Lift on Low Pressure.

Frequently injectors are used with very low steam pressure under circumstances where the water must be lifted from deep sources. To illustrate: We wish to supply a boiler carrying from 20 to 30 lbs. steam pressure, and the water supply is 18 ft. below the location of the injector. Under such conditions, it would not be possible to create a partial vacuum in the supply pipe sufficient to permit the atmosphere acting upon the surface of the water, to force the water up to the injector.

This is so, because when an injector is being started on a lift, the vacuum enabling the lift is created by the velocity of the steam through the tubes, the air in the suction chamber and supply pipe of the injector being exhausted by the friction caused by the jet of steam through it. At the pressure of 20 to 30 lbs., this velocity is not high enough to create a vacuum that would permit water to rise above 10 ft.; therefore, to raise the water 18 ft., other measures would have to be employed.

In such cases I have arranged an auxiliary tank with piping, as illustrated by Fig. 1. The auxiliary tank is represented by the letter F. A few gallons of water are placed in this tank for the purpose of giving the injector a start.

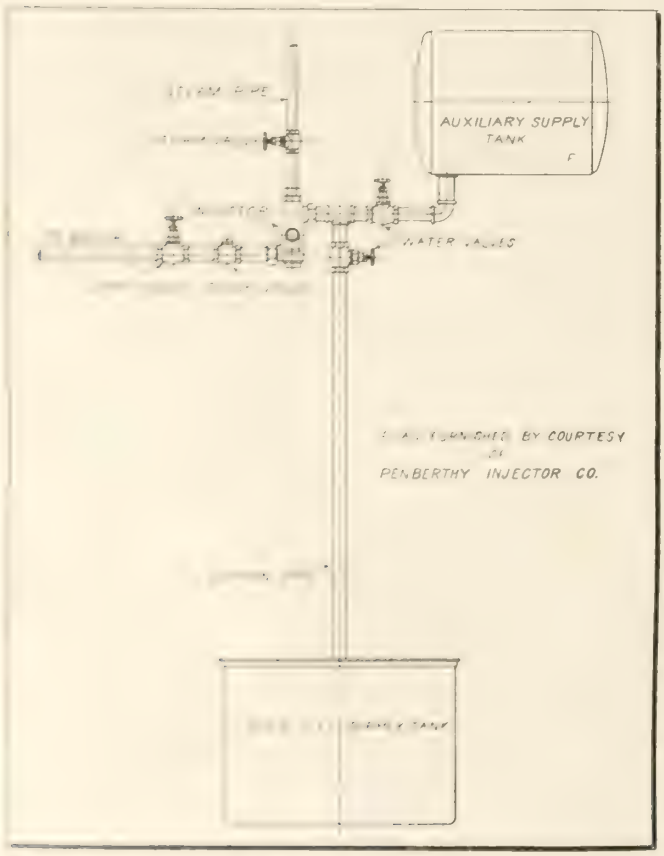


Fig. 1.—Arrangement for high lift with low steam pressure.

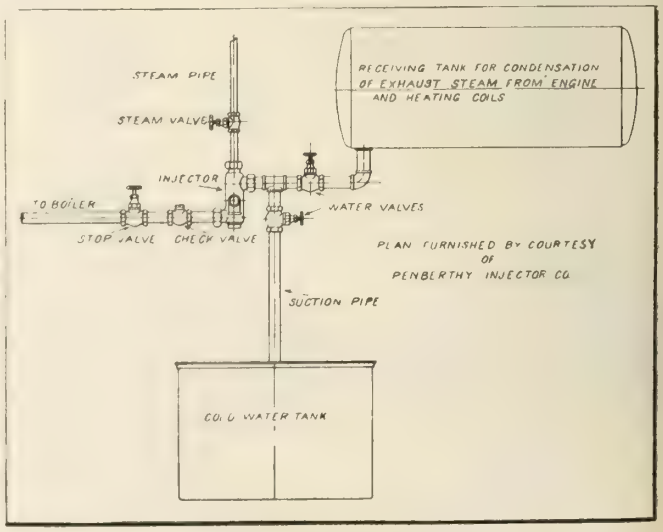


Fig. 2. Plan for handling very hot water with an injector.

When starting the injector, the valve controlling the flow from this tank is opened first, then the valve in the steam pipe is opened; the valve from the tank being throttled until the injector begins to work. After the injector is started, open the valve in the main suction pipe leading to deep tank.

Water will rise from the deep tank and the cause of its rise is as follows: We have noted that the injector when working with but 20 to 30 lb. pressure could not give sufficient velocity to the steam to create by friction a partial vacuum high enough to permit the water to rise above 10 ft. When the injector has been started with the supply from the auxiliary tank, the vacuum in the injector is being created by the condensation of the steam by water. This causes a very much higher partial vacuum in the injector than could have been formed by friction. Since this vacuum caused by condensation is higher, its effect produces a greater rarity of air in the suction pipe to the deep tank and the water rises.

The valve controlling the supply of the auxiliary tank may now be closed and the injector will continue to work lifting its supply from the deep tank.

Water Supply Hot.

Perfect operation of an injector depends upon the temperature of the supply water. If the water is too hot it will not condense the steam rapidly enough for the injector to operate. Injectors are often wanted to take their supply from tanks which receive the condensation from exhaust of engines, and from steam heating coils. The temperature of such supply often reaches 200 deg. F., which is too hot to do much condensing, and therefore injectors will not handle this supply.

Fig. 2 illustrates an arrangement of tanks and piping for an injector when it is desired to use very hot water. The upper tank contains the hot water and the injector has a suction pipe into this tank. When starting the injector, open the steam valve, then open the valve in suction pipe to cold water tank about half way; when injector is started, open the valve to hot water tank gradually until a slight spill comes from the injector overflow. In this manner the hot water mixes with the cold, its temperature is reduced, and the injector will work the hot water from the upper tank.

Overheating Supply on Traction Engines

Considerable trouble has been experienced in operating injectors on traction engines, especially in cases where the engines have a steam siphon or ejector to lift the water into the engine tanks from wagon tanks, brooks or other sources, and from which engine tanks the injector is expected to deliver it to boiler. The siphon or ejector being operated with steam, the heat of the steam is imparted to the water, often adding to the temperature to such an extent as to render the injector inoperative.

Since on traction engines there are many different methods of arranging the injector piping, it is impossible to take advantage of any special piping plan that would aid the injector to handle the water from engine tanks in all cases. It is, therefore, necessary to make tubes of special form for the steam siphon. I cured the trouble caused by the heat added in the operation of the siphon, by constructing the tubes so that the work of siphoning would have to be done by the ejector entirely, in lifting the water from below its position.

Ejectors or siphons are commonly made to work partially by lifting from below and partly by elevating above their position, but for traction engine uses it is not required that ejectors elevate greatly above their position, and the construction of tubes for ejectors, which permit the use of steam for elevating to great heights, is not necessary but harmful for such engines.

By constructing the tubes to work entirely by lift, a very small quantity of steam is required, merely sufficient to maintain a good partial vacuum, for having this vacuum it is obvious that the atmosphere, pressing on the surface of water being siphoned, is doing the work of pushing the water up to the ejector and into tanks without the addition of much heat from the steam that the ejector uses. Therefore the water reaches the engine tanks quite cold, and there is no trouble in having the injector deliver the water from the tanks into the boiler.

FEED WATER PURIFICATION.

(By Joseph W. Hayward, M.Sc.)

ONE plant, one purpose, is as good a rule in engineering as one man, one vote, in politics. A steam boiler is a plant for turning pure water into steam. It should not be made to serve the secondary purpose of turning foul feed water into pure. Most sources of feed water are impure, the supply containing acids or matter in solution which will be deposited in solid form when the water is evaporated. It is the purpose of the present article to discuss the most common impurities, and to indicate the best methods of dealing with them.

Water drawn from lakes in certain mountainous districts, though otherwise of high quality, may contain traces of acid, formed from the decomposition of vegetable matter, which will attack the clean plates of a new boiler. This acid is readily neutralized by passing the water slowly through a storage tank partially filled with broken limestone. Blue litmus, which can be purchased of any druggist, is turned to a red color by acid, and thus forms a ready and delicate test for acidity. Water containing fine vegetable matter in suspension may be clarified by adding to it a very small quantity of alum. The main trouble with spring and river waters is that they always contain more or less matter in solution, rendering them "hard." The terms "hard" and "soft" refers to the suitability of water for household rather than for steam raising purposes. Even soft water may contain troublesome solids in solution. Substances causing hardness can be divided into two classes, those causing temporary, and those causing permanent hardness, according to the difficulty encountered in ridding the water of them.

Temporary Hardness of Water.

Temporary hardness is due to the presence of calcuim carbonate, (limestone), or magnesium carbonate. One or both is found in all waters coming from a limestone district. These substances are not soluble in pure water, but only in water containing traces of carbon di-oxide gas, which may be absorbed from the air or some other source. The gas is driven off by heat, and the lime or magnesia is then deposited as scale. The temperature of an open heater is high enough to get rid of all temporary hardness.

A method of removing temporary hardness, commonly and successfully used in the south east of England, is to stir some freshly slaked lime into the water to be treated. This lime combines with the gas in solution, forming calcuim carbonate, and the new product is deposited along with the old. The process of settlement is a slow one, and large storage tanks are necessary, but the running expenses of such a purifying plant are comparatively small.

Permanent Hardness of Water.

Permanent hardness is caused by the presence of such salts as calcum sulphate, or gypsum, which is sparingly soluble in pure water at temperatures below 300 degrees F. It cannot, therefore, be got rid of in an open feed heater, or any heater where exhaust steam is used. It will be deposited in a live steam heater, under pressures of 50 pounds and upwards, corresponding to the temperature stated. If it is not removed previously, it will be deposited as a hard objectionable scale in the boiler itself.

The cheapest way of treating water for permanent hardness is to dissolve in it some "soda ash" or crude sodium carbonate. This does not render the water pure. It only removes one source of trouble at the expense of introducing another. The sodium carbonate combines with the calcium sulphate in the water. Calcium carbonate is formed, which is precipitated as mud, and also sodium sulphate. The latter is readily soluble, and remains dissolved after the water is pumped into the boiler. As more and more water is evaporated, the solution naturally would become stronger and stronger, till the limit of solubility was arrived at. The danger point, however, is reached much sooner, for a very moderate concentration of sodium sulphate causes the water to froth immoderately in boiling, and sets up violent priming. Consequently, in plants where this method of water treatment is employed, the periodic blowing down of every boiler must not be neglected. Boilers vary very greatly in their tendency to prime. Those of the water tube type, with a rapid circulation and small steam space, are great offenders.

Nearly all patent boiler compounds depend for their action upon the inclination of sodium and calcium salts to change partners in solution, as instanced above. Some soluble sodium salt is left in the solution, and calcium carbonate is deposited. As the latter forms a less hard and tenacious scale than calcium sulphate, a real advantage is derived from their use.

By adding a proper quantity of barium carbonate or barium aluminate to permanently hard water, insoluble salts of both barium and calcium are formed, which are precipitated and leave the water perfectly pure. Barium salts, unfortunately, are sufficiently poisonous to render the accidental drinking of water treated thus, dangerous. The only real objection to this treatment is, however, its expense

Question of Smoke Emission from Factory Chimneys*

By Dr. John S. Owens

The Author of This Paper Deals With the Subject in an Attractive and Interesting Manner, and Shows How Impossible it is for Any Municipality or Civic Corporation to Enforce a Smoke By-law, on Account of the Indefiniteness of the Well-known Term "Black Smoke," Particularly on a Basis Applicable Equally to Large and Small Plants.

My primary object in bringing this paper before you is to suggest the basis for a discussion of the question of a smoke emission standard, in the hope that some properly organized effort may be made to deal with the difficulties which have hitherto prevented its adoption. I do not think that anyone will contradict me when I say that the emission of dense smoke from furnaces consuming bituminous coal is unnecessary and indicative of waste of fuel and bad furnace construction or working. It is true that there are a few special cases, such as heating brewery vats and pottery kilns, where the emission of dense smoke for short periods is by some still considered essential, but it is open to question if this opinion is justifiable. At the same time, it should be remembered that the total absence of all smoke is in practice usually impossible of attainment when the economy of manufacturing processes requires the burning of bituminous coal.

An illustration of the difficulty of avoiding all smoke is provided by the large electric generating stations, where unforeseen variations of load occur, such as the increase due to a London fog, with its accompanying demand for artificial light. In such a case as this, it may be necessary to fire up fresh boilers very rapidly, and there is no known furnace which will admit of the smokeless combustion of bituminous coal, until the temperature of the combustion chamber has attained a sufficient height. Even in steady working, it is practically impossible to avoid all smoke; a faint brown smoke is regarded as indicating more efficient working of boiler-furnaces than none at all. The emission of some smoke may, therefore, be regarded as inevitable.

*Paper read before Section G of the British [illegible]

Dense Smoke Unnecessary.

The present position, therefore, is this: we know that dense smoke is unnecessary, and that entire absence of smoke is impossible of attainment, but we have not yet settled what, being fair and reasonable, should be permissible in the way of smoke, having regard to the improved methods of combustion which are now at the disposal of manufacturers. This is the question, an answer to which is, I submit, within our reach and should be sought for.

The Public Health Act of 1875 supplies the present standard by which smoke is judged throughout the country, except in the case of a few important cities possessing special powers on the subject. In this Act it is stated that "Any chimney not being the chimney of a private dwelling-house sending forth black smoke in such quantity as to be a nuisance shall be deemed liable to be dealt with summarily under the Act. There is an alternative method provided by this Act, under which proceedings can be taken in respect of fireplaces or furnaces in connection with factories which do not "as far as practicable consume the smoke arising from the combustible used therein." In practice, however, it has been found that this method of abating smoke is unworkable, owing to the lack of some standard defining the meaning of the words "as far as possible." The standard "black smoke in such quantity as to be a nuisance" takes cognisance of of two separate things in relation to smoke: its quality—that is, it must be black; and its amount—that is, enough to cause a nuisance; but, while these two essentials are taken into account, it is done in such a way that it would be practically impossible to prove in any particular case, either that the smoke was black, or that it was in sufficient quantities to be a nuisance. The point I wish to make is that the two essentials, kind and quantity, form part of the standard.

A Question of Public Interest.

Since the date of the Public Health Act of 1875, sufficient improvements in the methods of burning bituminous coal have been made to call for a reconsideration of the present standard, and the adoption of a more up-to-date one, which will conform in a reasonable way with the possibilities of modern practice. It is unnecessary to deal at length with the evils attending the emission of smoke, from the point of view of the public. They have to breathe the smoke-polluted air of cities, useful energy and money have to be expended in cleaning away soot, buildings are injured and blackened, the daylight and sunshine are cut off, and in many other ways harm is done which, to a great extent, might be avoided if we had a sound, legally-enforced standard for smoke emission, based on the known results which the proper application of modern methods of combustion give. Manufacturers would then use the best methods of combustion and the most

suitable appliances. The loss to the manufacturer in soot, estimated as a percentage of his fuel bill, is probably not more than a ¼ to 1 per cent., and this is not great enough to induce much effort to save it. On the other hand, the loss to the public due to the injuries inflicted by smoke is certainly many times greater; hence it is more to the interest of the public than of the manufacturer to reduce smoke.

Standard of Efficiency of Methods and Appliances.

One difficulty which has always existed is that of dealing with large and small fuel consumers by means of a single standard, and this has militated against the establishment of a more rational standard than that laid down in the Public Health Act. Clearly we cannot limit a large manufacturer to the emission of the same total quantity of soot as a small one. His furnaces might be better designed, and combustion more perfect, than in the case of the small consumer, but the total quantity of soot emitted might be much greater. Such a limitation would therefore work unfairly against the large fuel consumer. At first sight it would seem that the total quantity of soot emitted by any chimney would be the soundest thing to limit, since it determines the amount of pollution of the air by soot from a particular source; but on closer examination it appears that this is not really the best basis. What we are concerned with is the total pollution of the air by soot due to all chimneys in any particular neighborhood. For example, the erection of an electric generation station where large quantities of fuel are burnt may, by displacing many small consumers who had previously to generate their own power, actually cause a great reduction in the amount of soot poured into the air. At the same time, the total quantity of soot emitted from such a station might be many times greater than that previously emitted by any one of the smaller power units which it displaced, in spite of the fact that the combustion might be better and the amount of soot per ton of fuel burnt much less.

What we may reasonably ask for, is, that the best and most smokeless methods of combustion should be used. If we could therefore fix a sound standard which would be some measure of the efficiency of the methods and appliances used from the present point of view, it would work no hardship against the large fuel consumer. We come then to the conclusion that what is wanted is a standard of efficiency of combustion from the smoke-prevention point of view. This must clearly take into account the amount of fuel burnt, and, if we could measure it, the proportion of the fuel passing out of the chimney as soot would be the ideal standard.

Measurement of Smoke Density a Basis of Comparison.

It is the aim of engineers to provide a definite quantity of air for each pound of coal burnt, hence the amount of soot per unit volume of flue gases would vary approximately as the amount of soot per unit weight of fuel, when the air supply is so regulated to suit the amount of fuel burnt. In such cases the measurement of smoke density would be a sound basis for comparison as to efficiency of combustion. It would also be a fair standard to fix, since it would measure the polluting power of the smoke emitted so far as soot is concerned. I therefore suggest that the word "black" in the present standard should be altered to "smoke of a density exceeding" some fixed standard. The standard, should, however, also include a time of emission, and the form suggested is "smoke which exceeds a certain density (as measured in a way to be determined), and which is emitted for a period exceeding so many minutes per hour."

Methods of Smoke Measurement.

It is necessary next to consider the question of how the smoke is to be measured, since this is an essential part of the problem of establishing a sound standard. We may set ourselves to measure any one of the following :—

1. Total quantity of soot emitted in a given time.

2. Weight of soot emitted as percentage of fuel burnt.

3. Density of smoke or weight of soot per unit volume of flue gases. 4. of density to a standard. 5. Color. 6 Opacity, or degree of blackness.

In addition to deciding which of these objects to aim at, we must keep in view that whatever method be used, it must give reasonable accuracy and a fair basis of comparison between chimney and chimney, or with a standard ; it must also be easily applied from outside the factory by a single observer. It may be mentioned here that the standard maximum adopted by the Alkalis Act, of 1906, for the emission of muriatic acid in smoke or noxious fumes is one-fifth of a grain per cubic foot.

Considering now the various methods of measurement referred to above :—

Total Soot Emitted.—This measures the amount of pollution by a particular chimney, but takes no account of the amount of fuel burnt. As stated previously, it would be unfair to limit a large fuel consumer to the same total quantity of soot as a small one, even supposing we could measure it in a practical way. Its estimation implies access to the chimney and at least two measurements — that is, density of smoke and volume of flue gases.

Percentage of Fuel Lost as Soot.—To measure the weight of soot as a percentage of fuel burnt is open to the same objections as the measurement of the total quantity, but it implies at least the measurement of density of smoke, volume of flue gases, and weight of fuel. It would be a fair basis for a standard, but is quite impracticable as a method for the use of sanitary inspectors.

Density.—A quantitative measure of the density of the smoke might be obtained by the filtration method, in which the soot from a known volume of smoke is trapped and weighed, but it would be too cumbrous for general use. Density can also be measured optically, in which case, access to the chimney or factory would be unnecessary. It would give a fair basis of efficiency of the plant, and a good basis of comparison whatever the quantity of fuel burnt, or diameter of the chimney.

Color.—The measurement of the color of smoke may be dismissed as useless, since color bears no relation to quantity of soot emitted or evil done by the smoke.

Opacity.—To measure the opacity of a smoke column or its degree of blackness, which is the commonly accepted method now adopted, is worse than useless, since it is misleading, because opacity alone, unless adjusted for thickness of column, is neither a measure of the density of smoke nor of the amount of pollution of air. The smoke from different chimneys cannot be fairly compared on this basis, because of their different diameters. All smoke-charts, such as the Ringlemann or Donkin, measure the opacity in a crude way ; similarly, photographic methods, by which a photograph of the smoke-column is compared with standard shades, are open to the same objections. Instruments in which smoked glass is matched to the shade of the smoke, and in which no adjustment is made for chimney diameter, are equally objectionable. In a word, all these methods are only useful to compare chimneys of similar diameter, or the smoke from the same chimney at different times ; when used for general comparison they are misleading.

Measurement of Smoke Density in Detail.

We are thus reduced to a measurement of smoke density as the only satisfactory basis to work on. I will, therefore, go into this method in more detail.

Suppose we can measure the weight of soot in a column of smoke 1 square

[illegible] and the same length as the diameter of the chimney.

Let S = [illegible] of soot to each [illegible]

Let V = velocity of flue gases in feet [illegible] per second.

Let D = diameter of chimney in feet.

The weight of soot in 1 cub. ft. of smoke will be $\frac{S}{D}$, and the weight emitted [illegible] per second

$$\frac{\pi D^2 V S}{4 D} = \frac{\pi}{4} D V S.$$

or D V S multiplied by a constant; that is, it varies as the volume of flue gases multiplied by the weight of soot per cubic foot. The amount of soot emitted will, therefore, vary directly as the volume of flue gases, assuming the density to remain constant. Or, if we measure only S, the amount of soot emitted will vary as S multiplied by V D. If we assume V to be a constant value, the weight of soot emitted will vary as S multiplied by D, and the density of the smoke as S divided by D. This shows that the measurement of S alone is of little use unless an adjustment is made for D, and it must be noted that all smoke-charts now in use measure something which depends on S alone, but neglects D. It also points to the conclusion that with an adjustment for D, the measurement of S can be made to give a fair approximation to the relative weight of soot emitted or to the density of the smoke.

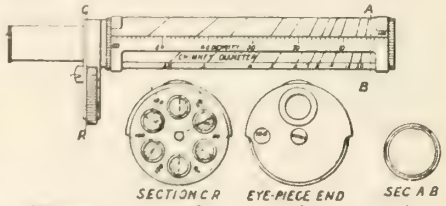
We can measure S indirectly on the basis of the light obstructed. For example we may compare the degree of opacity of the smoke with a smoked glass which obstructs as much light as a smoke column of known density and thickness. Suppose, then, we take such a glass of an opacity equal to that of a column of smoke of unit thickness and standard density, we might prepare an instrument having several shades of such glass, the lightest being the standard for the smallest chimney, followed by other shades made by super-imposing various thicknesses of shade 1, corresponding to various thicknesses of smoke-column or chimney-diameter. We could then, by comparing the smoke at the top of a chimney with such a set, say whether or to what extent the standard was be[illegible]

Suppose, for example, the smoked glasses are numbered in the ratio of their thickness, and that No. 1 matches a smoke of density G in a one-foot column, the density of smoke matching glass No. N in a column D feet thick will be $\frac{G}{D}$, that is, the density will vary as $\frac{G}{D}$, and can be given quantitatively by calibrating shade No 1 to correspond with a known density of smoke in a column one-foot thick. If we attempt to measure the opacity or light cut off by the smoke, we get a figure which does not bear a simple relation to the smoke density such as is borne by the thickness of the smoked glass which matches the smoke. I refer to this, because attempts have been made to measure the light obstructed as a basis for comparison between smoke from different chimneys.

Assuming, then, that we can observe with fair accuracy the density of smoke by such a method as I have described, the next step is to fix a certain maximum density which must not be exceeded. This could probably be best defined as: Such a density as would, when viewed by transmitted light alone, and in a layer of a certain thickness, permit to pass through it a certain percentage of the light falling on it. This might be referred to as standard density. With improvement in furnaces and appliances for the more perfect combustion of bituminous coal, this standard could be altered so as to represent fairly what might be expected from the current state of knowledge and invention.

Instrument for Comparison With Standard.

It would be necessary then to provide an instrument to enable a comparison with such a standard to be easily made. The accompanying drawing illustrates one which I have designed to meet the requirements laid down in this paper.



Figs. 1 2 3 4
Instrument for measuring smoke emission from factory chimneys.

It is in the form of a small telescope, having fixed, in the optical system at a point which may be brought into the focus of both object-glass and eye-piece, a revolving eccentric disc containing a number of graduated smoked glasses arranged in cells round the centre. The glasses only fill half of each cell, so that by revolving the disc, as each cell with its glass is brought successively into the axis of the telescope, the smoke may be viewed through the open half of the cell and matched to the glass in the other half. The glasses are numbered in the ratio of their thickness, and a table is provided giving the number of the glass divided by the diameter of the chimney, and, therefore, a figure which is a measure of the density of the smoke. It can be made to read the actual weight per cubic foot of soot in the smoke, if desired. This, of course, necessitates the inspector knowing the chimney diameter in this district; but these may be tabulated once for all. I have found, with instruments for smoke measurement, when the smoke is viewed through a small aperture, as is essential in order not to take in too much background, that it is impossible to get true data, owing to the eye being unable to focus at the same time the object aperture and the object; so that the edges of the aperture are hazy and ill-defined. This results in the whole aperture, when small, being overlaid by a hazy film, due to its ill-defined edges, which film prevents accurate readings of the smoke shade. The same applies to the aperture containing smoked glasses for comparison.

There are many difficulties remaining, which apply to all optical methods of measuring smoke, but before enumerating these, it is well to remind you that we have no other means of attaining our object, since all methods requiring access to a factory or a chimney are useless from the sanitary inspector's point of view. It is easy to imagine the welcome such an inspector would get on presenting himself at the door of a factory and announcing that he had come to measure the density of the smoke from the chimney; even assuming that he was given access to the chimney, it is unlikely that the dense smoke he had seen from outside would be permitted to continue for him to measure. I draw attention to this, so that while recognizing the difficulties in the way of applying optical methods of measurement, too much weight should not be given to such difficulties, nor should the presence of drawbacks to a method prevent its use if it fulfills its purpose, and a better is not forthcoming.

Factors Influencing the Apparent Density of Smoke.

Turning now to a short review of these difficulties, it is well to consider what are the factors which influence the apparent density of smoke, as given by an observation based upon its degree of blackness; these are:—

1. The true density of the smoke.
2. Diameter of chimney.
3. Background of smoke and shade it is compared with.
4. The color of the smoke particles.
5. The size of the smoke particles.
6. The amount and color of the light falling on the smoke from the observer's side.
7. The direction of the line of vision.
8. Presence or absence of wind.
9. The observer's personal factor.

Continued on page 325

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. IV NOVEMBER, 1911 No. 11

THE BLACK SMOKE QUESTION.

READERS of The Power House will find much that is educative and valuable in the two articles touching the "Black Smoke Question" in the present number. That referring to the regulations for "Firing Marine Boilers on the Chicago River" has much to commend it to the attention of stationary engineers and firemen, making clear, as it so effectively does, by text and illustration, the measures to be adopted and precautions to be taken to minimize the outpouring of black smoke, so far as steam boilers generally are concerned.

The second article, "Smoke Emission from Factory Chimneys," deals with the subject from what might be termed the municipal or public health aspect, and goes to show how hopelessly lacking, in definiteness and "basis standard of rating," are the many by-laws, whose aim is to regulate and so abate what is conceived to be more or less of a nuisance. A plea is put forth by the writer to secure such a method of test and its application, as will ensure that for steam power plant installations of every grade and size, there will be a uniform standard of volume and density which may not be exceeded under penalty.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ON another page of this issue will be found an appeal in the form of an open letter to operating stationary engineers of the Dominion, calling upon them to support and become members of the C.A.S.E. The letter is from the pen of the energetic secretary of the association, and will, we hope, be productive of beneficial results

It has always seemed to us that the C.A.S.E., and its executive particularly, are either not doing all they might in the matter of work for and attention to the interests of the organization, or they do not give enough publicity to their aims, efforts and achievements. The aims of the association are most worthy, but we do not believe that the efforts and achievements are commensurate. A three-days' convention each year, no matter how reputedly successful, is, after all, more or less of a social and goodfellowship function. The time devoted to serious and important questions affecting the profession is ridiculously meagre, and little wonder it is that to most individuals connected and unconnected with the organization, there is suggested the opinion and idea—"nothing doing," "nothing done."

Men honored with a place on the executive of the C.A.S.E. cannot, we know, give their undivided attention to the propagation and efficient carrying out of the association's work, but they are expected, in return for the confidence reposed in them by their fellows, to accomplish some continuous, definite and desirable progress. On the shoulders of the executive falls, we might say, the whole responsibility, which assumed heartily and acted faithfully upon, or otherwise, is really the determining feature as to the worth or worthlessness of the organization's existence.

We believe the C.A.S.E. has a place and part to play in this Dominion of Canada, but we do not believe that it is filling that place and performing that part to the best of its talented ability and according to its opportunity. An almost universal demand for the highest possible efficiency is being made on every man, at the present time, who has to earn his own living, and it needs no prophet to foretell the effect that such a demand will produce in association and similar spheres of work. Men will, through sheer force of habit at their daily toil, most naturally look for the same conditions in their social and trade organizations, and if they don't or cannot find them, or cannot get them, they will assuredly cut loose. If the C. A. S. E., with their highly commendable foundation principle of organization, mean to keep afloat and secure not only the confidence of operating stationary engineers outside, but within its fold, it must needs become, to a very great extent, more publicly aggressive in its work. It is in no way surprising that many men, who should be in its ranks, do not even know of its existence, while many others again keep themselves aloof, and simply "shrug their shoulders" on being interrogated on its behalf.

The Canadian Association of Stationary Engineers has in the past justified its existence and brought credit and place to its organizers, their successors and the profession generally, but a new age requires more and higher attainments than yet recorded, and these in face of more exacting conditions and circumstances.

Is the C.A.S.E. going to rise to its new place and opportunity ?

TIME LIMIT FOR TENDERS.

IN our view, the period allowed from the date of publication, or receipt of tender forms by the contractor or his representative, is in most cases totally inadequate, and seems in addition to bear no proportion whatever to the amount of contract price involved. Surely in such matters, opportunity should be given to go carefully into the requirements called for, by all desirous of submitting a quotation, as only thereby will fair competition have its rightful stimulus, and the best possible equipment be secured at the best possible price.

Much of the discussions on higher efficiency hinge on the workman's pay roll, his output in relation to it, and but little is heard of inefficiency otherwise. In the broad outlook, large opportunity awaits the "efficiency expert's" attention, as in this particular phase of "open tender," we believe betterment and all-round benefit to be derivable.

THE STEAM TURBINE.

At a recent meeting of the Institute of Marine Engineers, Sir Charles Parsons, who was in the chair, said that when turbine work was first started, great difficulty was experienced in stopping the leakage over the blades, which in some cases amounted to between 30 and 40 per cent. In re-action turbines of the marine type especially, the initial pressure was less efficient than the low pressure. In the low-pressure blades on the Mauretania, the leakage was practically nothing, and their efficiency was about 85 per cent. In turbines of the impulse type, such as the Curtis, there was greater efficiency in the initial stages, but the frictional loss was higher. A compromise has been arranged by which the Curtis turbines were made with the Parsons blading for the low pressure, and the Parsons turbine with the Curtis blading for the high pressure; about 70 per cent. of the whole power being of the re-action type. He considered that re-action blading would finally supersede all others. In actual practice, error in blade area made very little difference in the turbine efficiency ; a difference of 50 per cent. in the area of the blading would not, perhaps, make more than 2 or 3 per cent. difference. The blades and orifices got silted up sometimes, especially in small turbines, through the use of fatty compositions. The coating could be cleaned off with paraffin. It was best to use pure mineral oil for lubrication.

POWER FOR TEXTILE MILLS.

With a view to providing the textile trade with an authoritative report on the relative merits of motive power, the Textile Institute have appointed, as a preliminary step, a special sub-committee, consisting of a secretary of the Textile Mill-Driving Joint Committee and two honorary secretaries, to represent the Institution of Electrical Engineers and the Textile Institute, to conduct an investigation into the various forms of mill-driving. There is an impression that electrical driving is making greater progress abroad than in the United Kingdom, and one of the objects of the investigation will be to ascertain whether there is any justification for such a belief. Attention will also be paid to reciprocating engines and turbines, on the one hand, and to oil and gas producing plants on the other. The investigation will be of an exhaustive character, and is expected to occupy more than a year.

The first step will be the collection of statistical information about the various kinds of motive power used in the United Kingdom, America, Canada, and continental countries. For this purpose the Textile Institute has been divided into five sections, each with a sub-committee, as follows :—Cotton, worsteds and woollens, linen, silks, hemp and jute. After obtaining statistical information, the Mill-Driving Joint Committee will decide the future course of the investigation, which will eventually cover :—(a) The relative merits of the different methods of obtaining motive power ; (b) the relative merits of the different methods adopted in electrical driving ; and (c) the relative cost of the power in relation to the output of material.

LARGE ROPE SHEAVE AND SHAFT BEARING.

THERE is illustrated in Fig. 1 a rope sheave 8 ft. diameter by 16 ft. 10 in. width of face, 14 in bore, and weighing 66,750 lbs. It was made in four sections with heavy return flanges, and when erected these were bolted together, making a solid, substantial job. It carries 72 wraps of

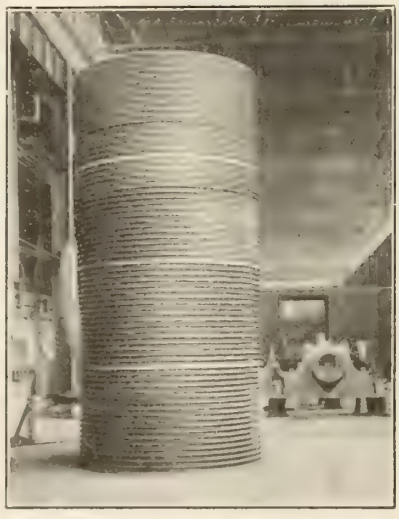


Fig. 1.—Large Rope Pulley made by The Dodge Mfg. Co., Mishawaka.

rope, and was designed for 4,000 h.p. at 187 revolutions per minute.

In order to carry the weight, a hollow shaft was designed with 20 in. bearings, bossed to 24 in. at the sheave hub, and having a 14 in. hole through its entire length of 28 ft. 6 in. That the weight of the coupling might be reduced, flanges were forged at each end of the shaft 30 in. diameter by 2½ in. thick to correspond with the flange couplings of the driven shaft at each end. The finished shaft weighed 24,375 lbs. To carry this enormous weight at the operating speed, a new design of bearing was used. Each mammoth bearing, Fig. 2, weighing complete with the base plate 10,600 lbs., is lined with babbit metal, and has a bearing surface of 20 inches diameter by 56 inches long. They are self-oiling, using two brass rings 1½ in. by ¾ in. to insure perfect lubrication.

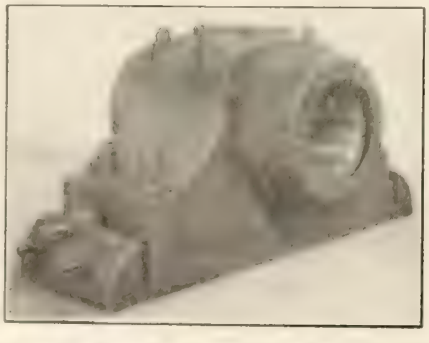


Fig. 2.—Mammoth Bearing made by The Dodge Mfg. Co., Mishawaka.

The whole outfit, now in operation, was furnished to the Pittsburg Plate Glass Co., Ford City, Penn., by the Dodge Mfg. Co., Mishawaka, Ind.

MIXED PRESSURE TURBINES.

The use of the mixed pressure turbine seems to be better appreciated in private than in public power stations, and there are many examples of generating plants which are neglecting this most attractive method of reducing costs. Whatever else happens, the mixed pressure turbine is a useful prime mover, whereas the pure exhaust turbine is only an appendage to the reciprocating sets. There is, however, a curious diversity of qualities in the machines offered by various makers. It is obviously important to aim at high efficiency in both sections—that is to say, when the set is running with live steam and when it is merely taking exhaust steam in the low pressure end—but there is a difference of opinion as to which is the more important, and while some makers have given special attention to the efficiency of the low pressure section, others seem to regard the high pressure consumption figures as alone of importance. It is clear, therefore, that the purchaser should make a careful estimate of the proportionate time during which he will probably elect to use the machine at full load with live steam or at other loads partly or wholly with exhaust. If there is much room for doubt, then the equated efficiency, taking the full supply of exhaust steam, should be made the decisive figure in comparing different tenders. Overload capacity is another question that calls for special consideration. As mixed pressure turbines are usually specified to deal with a given quantity of exhaust steam available, it is of doubtful advantage to demand a machine capable of taking more.

Labor and capital combined are said to produce all the wealth of the world. How is it, at this time when labor is walking the streets idle, and capital is searching for investment, that the combination fails to be put into action?

Progress and Development of Hydraulic Engineering

No Apology is Necessary for Our Featuring Hydraulic Engineering in Canada. This Country Lends Itself Naturally to a Development and Progress Along the Lines of Every Description of Water Power Equipment, and the Idea in This Particular Section of Our Paper is to Make Known What is Doing and Who is Doing it Throughout the Whole Field.

OIL PRESSURE GOVERNOR.

AN oil pressure governor, manufactured in seven different sizes, has recently been put on the market. The general arrangement, as will be seen in the accompanying illustration, is designed with a view to creating a controlling device, complete in itself, independent of any other appliances, and compact, so so as to occupy the least possible space and facilitate inspection and handling. All parts, such as the oil-pump, pendulum, air vessels, controlling valve and excess pressure valve, are mounted on a massive cast iron casing, which serves at the same time as bedplate and oil reservoir. The governor thus forms one single unit, which may be easily fitted to turbines already in service or otherwise.

Power for Regulating Mechanism.

The power, required to operate the regulating gearing of the turbine, is generated by a servo-motor, with differential piston, the cylinder of which and the casing are cast in one piece. The smaller cylinder of the servo-motor is kept constantly under pressure, and the larger cylinder is alternately connected by means of the controlling valve, with the oil reservoir or the air vessels (pressure chamber); through these the piston is moved, and control of the water supply effected.

The governor is worked by oil of a special kind, at a working pressure of about 220 lbs. per sq. inch. This pressure is created by a pump of the triple piston valveless type, fitted to the lower part of the casing. The oil enters the pump from the oil reservoir (casing), and is subsequently forced into the air vessels. If the supply of pressure oil is larger than the demand, the excess pressure valve will open and allow the oil to go back into the reservoir.

The Oil Pump.

The oil pump is as a rule driven from the main turbine shaft by belt, and as a consequence, when starting the turbine, the governor gearing has first to be moved by hand until the requisite oil pressure be created and the automatic governor can be put into action. A hand governing device is therefore, also provided, and has to be used each time, when no oil pressure is available. In order to be able to control the machine from the start by the automatic governor, a small separate turbine requiring from 1 to 3 h.p., may be attached to oil-pump. By running this turbine for some minutes, sufficient pressure is soon available, and the main machine can then be started by turning the small hand-wheel, attached to the gearing, between the pendulum and controlling valve. Such an arrangement has been greatly appreciated in cases where large units are installed, and have often to be shut down and re-started.

Patent Automatic Stop-Valve.

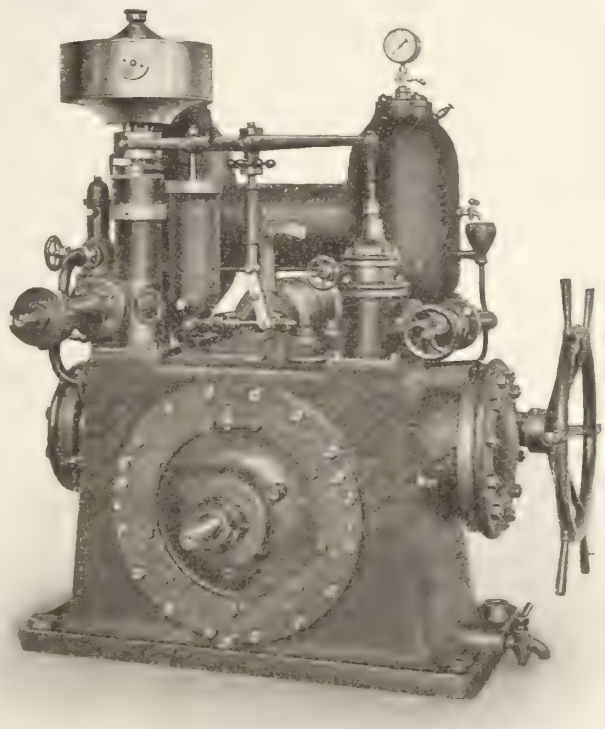
An important feature of this standard governor is the patent automatic stop-valve, which automatically shuts down the turbine, should the belt, driving the pendulum, break or come off. Further this governor has only one single small stuffing-box, on the pump shaft, so that the use of packing material is reduced to a minimum. All pistons are ground-in completely tight, no packing being required.

We are indebted to Escher, Wyss & Co., Lumsden Building, Toronto, for the cut accompanying this article.

GEARED TRIPLEX POWER PUMPS.

THE geared triplex power pumps, herewith described and illustrated, embody the principle of the three-throw crank shaft, with crank pins at an angle of 120 degrees to each other. By this arrangement, the strokes follow and overlap one another, resulting in a continuous and uniform action upon the fluid pumped, and insuring an easy flow through the delivery pipe, with corresponding high degree of efficiency in operation. These triplex pumps, whether of the low service, medium or heavy pressure types, have the plungers with crossheads outside guided, thereby relieving the stuffing-box glands of lateral pressure, due to side thrust of the connecting rods.

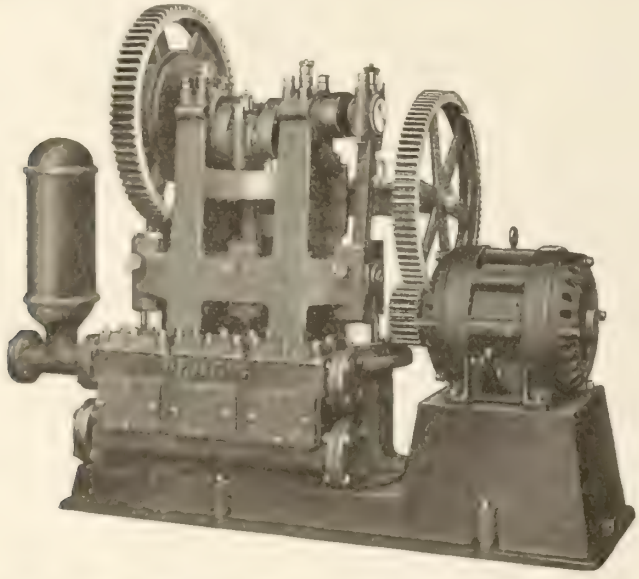
The main housings, or guide columns, are of the box girder type, and contain two bearings of extra large dimensions, which support the crank shaft. The latter is made of best grade open hearth steel casting, in one piece, with all bearings of unusually ample dimensions. Integral with the shaft is a large flange to which is bolted the main gear; this being accurately recessed to gauge, to



The Escher Wyss oil pressure governor.

fit the flange. If, for any reason, a crank gear has to be replaced, it is not required to take the shaft apart, but instead, it is only necessary to disconnect the crank end of one connecting rod, remove a few nuts from the bolts which fasten the gear to the crank shaft flange, slip the gear from its place, and reverse the operation with the new gear. This can be done in most cases, without removing the shaft from its bearings.

The gears are provided with a large central flange, accurately recessed to gauge to fit over the flange on the crank shaft. They are made of best grade cast iron of high tensile strength, and have machine cut teeth of involute form. The connecting rods, with the exception



Size 5½x8, type B. drive, Deming geared power pump.

of those on pumps of smaller sizes, are made with boxes of marine type at the crank end, and with bronze boxes in halves, having wedge and screw adjustment, at the crosshead end. For the smaller sizes, the rods have removable bronze bushings in the crosshead ends. The plungers, in all pumps, are of the outside guided type, and are provided with crossheads, which, except again in the smaller sizes, have bronze shoes adjusting of adjustment for taking up wear. The construction also is such that the crosshead pins are continually submerged in a bath of oil. The crossheads run in guides, which are bored to a true circle. The water cylinders are provided with deep bolted gland stuffing boxes, packed from the outside, and in [illegible] pumps have removable bronze liners.

The valve chambers, except also in the smaller sizes, are separate from the [illegible] and are bolted to same. They [illegible] exceptionally large valve areas, [illegible] of suction and discharge [illegible] accessible through large [illegible] removable covers [illegible] suction and discharge connections may be made at either or both ends of the pump. The material and workmanship, entering into construction, are kept up to the highest standard, and as all parts are made to gauge, they are strictly interchangeable. Every pump is subjected to a thorough test before leaving the factory, and is fully guaranteed to be exempt from faulty construction, and from defective material or workmanship.

The Deming Company, Salem, Ohio, are the manufacturers of these pumps.

FEDERALITE PUMP VALVES.

H. L. PEILER & CO., Montreal, Toronto, Moncton and Winnipeg, well known as the representatives of the Bundy steam trap, have recently acquired the agency for "Federalite Pump Valves." These valves are made of compressed cotton fibre by a special secret process, and have been subjected to exhaustive and severe tests. While cheaper than rubber valves, they are guaranteed to last from 3 to 5 times as long under like conditions. The manner and ingredients of which they are made give them great strength, both in tension and under compression. They are not affected by water (hot or cold), pure ammonia, oil (hot or cold), ordinary acids or alkalies, lye or potash, creasote, gasolene, or lime.

Among other advantages, are the following:—They are always flexible in water, suitable for either fast or slow work, unaffected by age or climate, stand any pressure, of less thickness than rubber, and have no tendency to get out of shape, if kept in water.

Federalite valve or plunger packing should be soaked for 24 to 48 hours in cold water, or 18 to 24 hours in hot water, before using. Repeated soaking does not hurt, but, as a matter of fact, expands the material to the required size. No lubricant is necessary, and if allowed to become dry, any lost shape is regained by soaking.

Among orders received recently for "Federalite Pump Valves and Packing" may be mentioned those for the C.P.R., the Montreal Street Railway, the Montreal City Water-Works, and the Canadian Light, Heat and Power Co. It should be stated that Federal pump valves and packing are specially adaptable for hard service on plunger pumps, elevators and general hydraulic machinery.

Another specialty known as "Federal Metallic Packing," in spiral, sheet and twist form, suitable for engine, ammonia and acid machines, is also represented by H. L. Peiler & Co., and is meeting with a large and ready sale.

THE "IDEAL" HEATER.

THE "Ideal" Heater is a combination feed water heater, purifier and oil extractor of the open or exhaust steam type. Its construction is such that all parts are easily accessible, and the material used reduces the repair cost to a minimum. By reference to the following illustration the action of the heater will be clearly understood.

The exhaust steam enters the bottom of heater at inlet 1, striking the oil extracting deflector 2, in chamber A, which is drained by open drip pipe 3 to sewer. Steam passes out of this chamber up tube 4, discharging into chamber B (there mixing with the descending water from filter F), then into chambers C and D through tubes 5 and 6, where it mixes with the spraying water, and passes through the opening at 7 to the heating coils or atmosphere.

Cold water is admitted at supply pipe 8 and sprayed into chamber D. Here it falls through the steam, gathering heat from it, and is distributed over filter bed E, where it percolates through about 18 or 20 inches of Excelsior. At the bottom of this material two to six layers of burlap are placed through which the water filters into chamber C in a fine spray, again mixing with the steam; the same process being repeated through filter bed F into chamber B. The water next passes down tube G into chamber H, rising through burlap and coke to the pure water hot well J

Referring to the numbers on illustration shown, 9 and 10 are by-pass pipes, useful only if filter beds become clogged or overcharged. 11 is the overflow and scum pipe which should discharge into a funnel connected to the sewer. 12 is the blow off cock, 13 the float regulating the rate of feed, 14 the suction pipe connected to pump, 15 the float handle, and 16 a double-seated balance valve for regulating water supply.

In operating care should be taken that the drip pipe 3 does not become clogged. The scum should be run off the water at least once every ten hours, and this can be done by pressing down handle 15 till the water rises to about the top of the gauge glass when it will be high enough to run out overflow pipe 11. The excelsior filter beds should be removed and renewed as found necessary. The frequency of this will depend on the quality of water used.

Societies and Personal

C. E. Vice, secy.-treas. of the Elmira Machinery and Transmission Co., has taken over the management; Wm. Brigham having resigned.

* * *

J. W. Kent, traveling representative of the Detroit & Pittsburg Coal Co., is working through Ontario. Mr. Kent reports business very brisk.

* * *

James W. Moncur, who for the past five years has been connected with the E. T. Wright Co., has severed his connection with that firm and has accepted the management of the Montreal branch of the Canadian Tungsten Lamp Co. Mr. Moncur takes over the office and warehouse at 30 St. Deserres St., Montreal, where a large and varied stock of all lines manufactured will be carried. He retains also his old territory from Kingston east to Halifax.

* * *

W. T. Grose, the Montreal manager of the Canadian Tungsten Lamp Co., has resigned his position as eastern representative on account of ill health. W. E. Ginder, the president, presented Mr. Grosse on behalf of the company with a handsome piece of silverware, suitably engraved as a slight token of the company's appreciation of Mr. Grose's hard work during the past three years.

* * *

C.A.S.E. Lodge 25, Owen Sound, report last month as having been a good one. Several new members joined and an educational class was started. The work of the latter has been heartily entered into by the brethren, and excellent results are looked for. Manufacturers' samples, models and catalogues are requested from those concerned.

* * *

The International Union of Steam Engineers, Local No. 152, has established a death benefit for the members who have belonged to the union for one year. Previous to this, the union paid only a sick benefit of $3 a week to its members. Mr. H. A. Scott, the business agent, and Mr. R. Sheppard were the actuaries on the death benefit gratuity, and they figured that the local union would be able to finance it on a payment of 60 cents a week by the members.

* * *

Lodge No. 30, C.A.S.E. continues to enrol new members each meeting night, and reports that the educational classes started at the beginning of the winter are progressing in good shape. Carpet ball is being introduced as an additional recreation for the members.

* * *

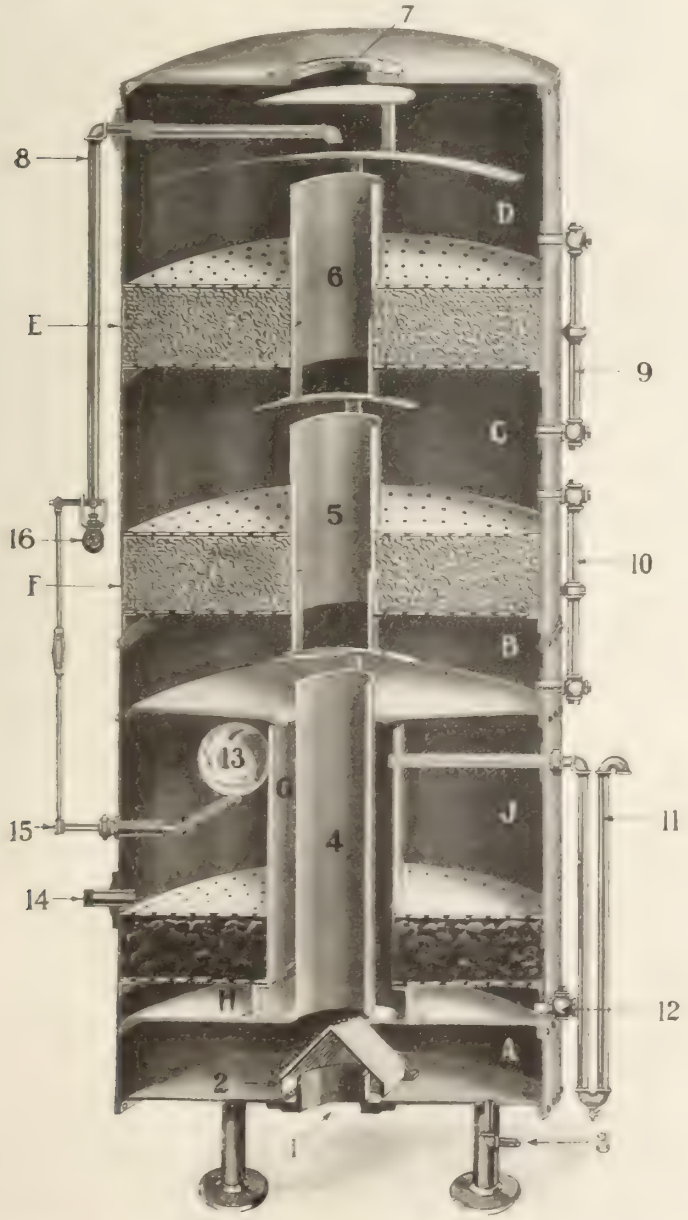
A. P. Johnston, of Pittsburg, organizer for the International Stationary Firemen visited the Labor Temple, Toronto, recently. Mr. Johnston will organize the stationary firemen of the city.

* * *

H. J. Glaubitz, superintendent of the Waterworks Department at London, Ont., proposes to employ the ultra violet system of water purification. The method is stated to have been used with considerable success in France and Germany.

* * *

A. L. Mieville, late assistant engineer, the power construction department, City of Winnipeg, has recently arrived in Toronto, after a trip to England, where he made arrangements with W. H. Allen, Son & Co., Bedford to become their resident engineer with Chapman & Walker, Ltd., Toronto, the Canadian agents of that firm. Mr. Mieville has had considerable experience with various firms in England, Canada and the United States, and his record is such that we look for the development of a large demand for the various Allen specialties of high speed engines, condensing plants, steam and water turbines, centrifugal pumps, fans and D. C. machines, through his efforts. Despite the fact that Mr. Mieville has been on duty for but a brief period, an order



The Goldie & McCulloch Co., Galt, Ont.—Feed water heater and purifier.

for a 300 k.w. D.C. set on the 3 wire system has been secured from the University of Toronto. The Allen products hold a high place in the esteem of marine, naval and stationary power plant engineers in most parts of the world, and their entrance to the Canadian market will doubtless more than warrant the firm's enterprise.

CANADIAN CASUALTY & BOILER INSURANCE CO. CHANGES.

C. Norie-Miller, manager of the General Accident Assurance Co. of Canada, has been promoted to the joint management for the United States of the parent company (The General Accident Fire & Life Assurance Corporation, Ltd., Perth, Scotland), at Philadelphia, in conjunction with John A. Kelly, of New York. John J. Durance succeeds C. Norie-Miller as manager of this company and the General Accident Assurance Co. in Canada. Following these changes, J. O. B. Latour becomes chief engineer, succeeding A. M. Wickens, who has been appointed executive special, a new department created for the furtherance of the company's business in the field

TURBO-GENERATORS.

A PAPER on "The Mechanical Design of Direct-Current Turbe-Generators" was read before the Manchester local section of the Institution of Electrical Engineers by Mr. R. J. Roberts. Much has been written on the electrical design of turbo-generators, he said, but still more experimenting and investigation were needed before knowledge in this direction could be considered to be sufficient. The mechanical difficulties were also great and just as important. The author exposed some of these difficulties and generally considered their solution.

Common Defects.

The more common defects were ound in the collecting gear. They took the form of sparking, which was not necessarily an electrical defect, and might arise from (a) unsuitable brush-gear or collectors; (b) want of balance generally, (c) unstable construction of commutator. Unsuitable brush-gear or collectors might be caused by the transmission of vibration from other parts of the machine, from insufficient or too much pressure on the brushes, or even from a brush-holder that permitted the brushes to rock. Want of balance was possibly caused from movement of some part of the rotor after original balancing, or [illegible] Further, if slight [illegible] taken in balancing each unit [illegible]

This probably might mean an eccentric displacement of the commutator surface in order to obtain good balance. Still another cause of this trouble might be the critical speed being too near the running speed, but this was very seldom seen in recent machines. By unstable construction of commutator was meant insufficient strength to hold together when running, or to remain true to its original axis of revolution after a period of running. This was seen by the rising of the insulating mica segments between bars, and might be due to defective mica, or to the movement of one or more of the shrink rings; or even to the failure of the support of the commutator bars (necessarily of some insulation) to stand the various expansion strains or the grinding action of flexure of the shaft relative to commutator.

Another common defect was found in the insulation. It was noticed that all high-speed machines, especially those working with forced ventilation, rapidly accumulated dirt or soot; and frequently it accumulated where it was impossible to clean, either by blowing or brushing. On direct-current machines it was impossible to do without exposed conductors, and this dirt accumulated and possibly bridged the creepage surface from conductor to earth, or from conductor to conductor. Again, the insulation, although of ample dielectric strength, might not be strong enough to stand the mechanical stresses put upon it.

The bands were another frequent source of trouble, and this trouble was the most disastrous of all. The bands over the armature end windings, whether of wire, forgings, or castings, sometimes broke, which, of course, meant a wrecked machine. A broken or bent shaft seldom occurred except after a burst. Practically the only defect of the stator was in the insulation, as the forces acting upon the stator conductors, due to a short circuit, were not so great as were found in the alternating-current turbo-generator.

Conclusions.

After discussing the construction of field magnets, shafts, rotor cores, rotor windings, commutators, etc., the author said that, in anticipating probable improvements of construction, it was apparent that one of the ultimate aims was the decrease in span between bearings. This might lead to a reversion to the Eickemeyer or butterfly winding for armatures, with the equalizers possibly combined in the end connexions. The radial type of commutator was possibly the ultimate general design, but it would be some years before this type was generally adopted, and in the meantime great improvements might be accomplished by the use of higher brush pressures and higher current densities and peripheral speeds. The brush-holders were still very far from perfect, and possibly the present almost universal box-type holder would disappear for some form of the old lever-type holder. The present ventilating schemes needed much improvement, and an air-cooling system with a separately driven circulating fan was a probable solution.—T.E.S.

THE AMERICAN PEAT SOCIETY.

Canadians took a leading part in the convention of the American Peat Society, which was held at Kalamazoo, Mich., on Sept. 21 to 23. Among those who attended the deliberations of the American body was Mr. Arthur J. Forward, secretary of the Canadian Peat Society. Mr. Forward has now returned.

Discussing the results of the convention of peat men, Mr. Forward said that a most important part was taken by the Canadians present including the presentation of a very interesting paper on the operation of the peat gas producer of the department of mines at Ottawa, by Mr. B. F. Haanel, of the mines department. Other Canadian speakers were Dr. J. McWilliam, of London, president of the Canadian Peat society; E. V. Moore, of Peterboro, and L. B. Lincoln, of Montreal, manager of Peat Industries, Limited.

The chief progress in the industry shown by the United States was along the line of agricultural use of peat bogs. It was also noteworthy that the principal gains in the production of fuel from peat were those which have taken place in Canada as a result of the establishment of the peat plant at Alfred, Ont., and the one in Ottawa. This progress was along two lines, machine peat for domestic use and in the employment of peat gas for the production of power.

Reports showed that the operation of both the government plants in Canada during the year had been very successful. About 2,500 tons of fuel were manufactured at Alfred. It was clearly shown by Mr. B. F. Haanel in his paper that the use of peat in a gas producer plant will be of great economic value in the way of providing cheap power in many localities. A detailed report on this subject will be issued in a short time by the department of mines.—Exch.

S. J. Rose, Query, re Government suction gas plants in operation.—We are not at the moment aware of any such, but suggest that you write the Department of the Interior and the Department of Marine and Fisheries, Ottawa, either of whom will be able to give you the desired information.

Series of Practical Questions and Answers for Engineers

By J. H. Williams*

Every Care Will be Taken to Select Practical Questions Arising out of an Engineer's Daily Routine; the Intention Being Thereby to Make the Series More Interesting and Valuable From an Educational Standpoint. Arithmetic up to the Multiplication and Division of Decimals, and the Extraction of the Square Root of a Number, Will Cover the Calculations Necessary.

Q—1. An engine is capable of raising 70 million pounds through a height of 1 foot on a consumption of 112 pounds of coal. How many pounds of coal does it consume per horse-power per hour?

A—1. One horse-power per hour is $3,300 \times 60 = 1,980,000$ foot-pounds of work. Therefore, the work done by the engine is equal to

$$\frac{70,000,000}{1,980,000} \text{ or } 35.35 \text{ horse-power per hour, consequently the coal consumption is } \frac{112}{35.35} = 3.168 \text{ pounds per horse-power per hour.}$$

Q—2. An engine of 70 H.P. uses 45 pounds of steam per horse-power per hour, including that required to operate the feed pump. The latter is of the double-acting duplex type, and has plungers 12 inches in diameter. What must be its stroke, if the efficiency of the pump is 50 per cent., and it is required to deliver 75 per cent. more water than is normally required by the boiler? A cubic foot of water weighs 62½ lbs.

A—2. Total water evaporated per hour is $70 \times 45 = 3,150$ pounds.

$$3,150 \text{ pounds of water} = \frac{3,150 \times 1,728}{62.5}$$

$= 5,443,200$ cubic inches.

Since the efficiency of the pump is only 50 per cent., the theoretical amount of water to be delivered each minute is

$$\frac{5,443,200 \times 100 \times 100}{60 \times 75 \times 50} = 241,920 \text{ cubic ins.}$$

Each plunger will deliver half this amount or 120,960 cubic inches, and since it makes 60 strokes per minute, it must deliver $\frac{120,960}{60} = 2,016$ cubic inches per stroke.

The area of a 12-inch plunger is $.7854 \times 12 \times 12 = 113.09$ square inches.

Therefore, the stroke must be

$$\frac{2016}{113.09} = 17.82 \text{ inches, say 18 inches.}$$

Q.—3. What steps would you take to remedy a hot main engine bearing?

A.—3. First loosen the cap a little and give the bearing a good dose of cylinder oil. This is sometimes effective. Another good remedy is a mixture of powdered graphite and oil, in the proportion of one part graphite to ten of oil. The oil and graphite must be well mixed before use. Flowers of sulphur or ground talc may be substituted for the graphite, if the latter is not available.

Q—4. What do you understand by the flash-point of any particular brand of oil?

A—4. The flash point of an oil is the temperature at which it gives off an inflammable vapor, and is generally read on the Fahrenheit scale. The heavier the oil the higher its flash point. Thus cylinder oil must be heated to a higher temperature than engine oil before the vapor given off will ignite. Hence the flash point forms a rough means of comparing the properties of various oils. A rough test of any oil may be made by putting a small quantity in an open vessel, and gently raising its temperature by means of a lighted taper, while at the same time a flame is held near the oil surface. Directly any inflammable gas is given off, take the temperature of the oil, which will be the approximate flash point.

Q—5. For measuring temperatures engineers in this country use the Fahrenheit thermometer scale, while electricians and scientists use the centigrade. How would you convert readings taken on the Fahrenheit scale to the corresponding reading on the Centigrade and vice versa?

A—5.—In what follows F. means Fahrenheit and C. means Centigrade.

On the F. scale, the freezing point of water is marked 32, and its boiling point is marked 212. In other words this fixed range of temperature is divided into 212-32 or 180 degrees. On the C. scale the freezing point of water is marked O or zero; and the boiling point 100 or a range of 100 degrees.

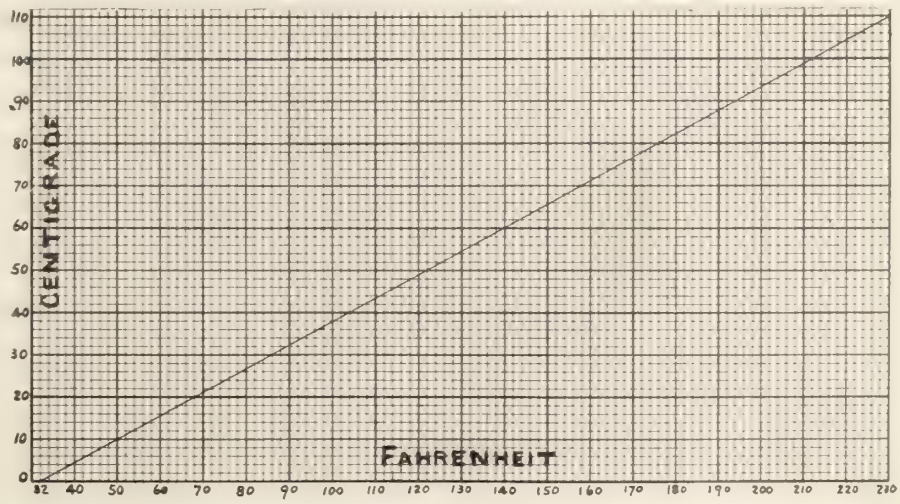
It therefore follows that 180 degrees F. are equal to 100 degrees C.

Dividing both by twenty, we see that 9 degrees F. are equal to 5 degrees C.

In other words, each degree F. is 5-9 of a degree C, and each degree C. is 9-5 of a degree F. The reading cannot, however, be merely multiplied by 5-9 or 9-5 in order to convert from one scale to the other, and a little consideration will make this clear. For example, consider the temperature indicated by a reading of 5 degrees C, which, of course, means above the freezing point of water. We have already seen that 5 degrees C are equal to 9 degrees F, therefore the corresponding reading on the F scale is 9 degrees above the freezing point of water or 41 degrees F. Hence, the following rule:

When converting from C to F, multiply the C reading by 9-5 and add 32, and when converting from F to C subtract 32 from the F reading and multiply by 5-9.

The chart shown on this page enables one to read off direct the corresponding readings on the two scales for any temperature between 32 degrees and 230 degrees F. For example, if we wish to convert 40 degrees C to the F scale, we follow the horizontal line representing 40 degrees C until it strikes the diagonal; from that point we follow the vertical line downwards to the F scale, and find that the corresponding reading is 104 degrees F.



Q. and A. 5—Centigrade and Fahrenheit chart.

*Associate Editor, Toronto.

REFRIGERATION DEPARTMENT

THE HIGH-SPEED AMMONIA COMPRESSOR.*

(By Theodore O. Vilter.)

THE high speed compressor is a feasible proposition. Its possibilities depend almost entirely on the area of the suction valve and diameter of the compressor. Years ago, I had an experience with an 11 by 30 inch compressor. I was called to a plant which was in trouble, to make recommendations. I found good insulation, plenty of direct expansion piping in the rooms, plenty of ammonia in the system, and the compressor operating at 75 r.p.m. I told the owner he must shut down to take out the compressor valves for examination, and also to ascertain the condition of the machine. I found that by operating the machine at about 36 r.p.m. we could cool all the rooms, and give the proper temperature without any trouble. The owner doubtless thought me ready for the insane asylum, for a good many engineers had called at the plant before I came, and all advised him to speed up. I told him that I would stay with the machine for twenty-four hours, and guarantee with a $500 check, which I was ready to deposit, that I would get an order to shut down because the cellars would be too cold before that time. He shook his head, but agreed.

Inside of fourteen hours, with the compressor operating at 35 r.p.m., the temperature was such that the brewmaster ordered me to stop. This proved that the valve area was entirely too small. With the same size valves put into an 8 by 16-inch machine, it would have carried all the rooms at the proper temperature when running 70 r.p.m., provided the compressor was given the proper clearance, therefore, it is the construction of valves that will bring about the increased piston speed without injury to its efficiency.

Tests with an 8 by 16-inch compressor of a certain construction show that 100 r.p.m. is the limit. An increase in revolutions would bring about a decrease in efficiency. A compressor of [illegible] diameter, and operating also with a [illegible] stroke, at 275 r.p.m., showed [illegible] increase in efficiency, and there was no trouble, although the suction [illegible] was nearly the diameter of the plunger, which shows that there is no limit to the handling of the gas with proper suction supply and proper valve area.

In practice, I am personally against refrigerating machines operating at a high rate of speed, just as I am against operating a steam engine at a high rate of speed, for the simple reason that the wear and tear is very much greater. A slow-operating compressor or engine will run for a great many years with but little repair, while a high-speed compressor or engine will require a great deal. This is much more apparent in an ammonia compressor, which operates 24 hours a day, seven days a week, 31 days a month, and, in tropical climates, 12 months a year. The owner of such a plant cannot afford to shut down every little while for repairs. Consequently, my argument is that the slower speed compressor is the proper thing for all-around conditions. There is no other saving than the first installation in buying a few pounds less iron. The workmanship must be a great deal better than the high-speed compressor. What I mean by a slow-speed machine, is, that with, say, from 50 to 100 ton refrigerating capacity, from 70 to 90 r.p.m. should be the proper speed.

The high-speed compressor requires a larger bore in proportion to the stroke, so as to get more surface to insert the proper valve area, and in large machine construction, it is impossible to make valves the full diameter, therefore, a multiple of smaller valves must be used. In order to get the increased area, the diameter must be increased and the stroke shortened for a certain capacity, and that, of course, increases the clearance, which is detrimental to compressor construction.

OPERATING AMMONIA COMPRESSOR BY AID OF THERMOMETERS.*

By E. N. Friedmann.

ON the question of competent handling or manipulating of a refrigerating plant, the owner may use the best care in placing his order; the manufacturer may, and usually does, use every means to produce a first-class outfit suitable for a particular purpose; the owner may be willing to buy the best materials, such as packing, oil, etc., and still, after all has been done in accordance with good business methods, the plant does not show the capacity or economy which may be reasonably expected, simply because the man in charge has never been properly instructed to run the plant according to common sense ideas, and particularly, make use of benefits derived from numerous tests made by the manufacturers and independent engineers. In other words, the plant, no matter how well constructed, is at the mercy of the operating engineer, and may be a success or a failure according to his knowledge. No one knows this better than the manufacturer. He naturally tries to protect his interests by inserting a clause in his contract that certain guarantees as to capacity, temperature and economy are based on the condition that the plant will be properly handled according to his instructions, and by a competent engineer; and he reserves the privilege of putting his own man in charge, if necessary to prove that the plant, if properly handled, produces the results guaranteed.

Routine of Manufacturer's Test.

Now, for illustration, let us assume that the performance of the plant is not satisfactory to the owner, who in most cases will have to rely on the statement of his operating engineer, and he demands that a test be made as to capacity, etc. What is the first thing that the manufacturer does? (I am speaking here of manufacturers of reputation and standing, not of some little pipe fitter who calls himself a manufacturer, after having helped erect machines for some one else for a few months, or even years.) He sends his men and inserts thermometer wells in suction and discharge pipes near the compressor, and at other places in the outfit where the reading of temperatures is of importance. In some cases these wells (as well as instruments) are already provided, but in most cases, as you know, they are not. This refers particularly to the ammonia compressor connection. Preliminary to test, and during the test, the temperatures of suction and discharge gas are carefully taken at very frequent intervals, proving thereby that he regards it

*Paper read at the American Society of Refrigerating Engineers' Meeting, St. Louis, October, 1911.

of great importance for his purpose of getting the best results. He also takes indicator cards, but does not seem to attach much importance to them, except to find out whether the valves are working properly, or a piston not tight. He regulates the back pressure for the particular plant and its prevailing local conditions.

Is it not natural to conclude, therefore, that if temperature reading is so important to the manufacturer to produce the best results, it is just as important to the owner, since naturally the closer he can run his plant to test conditions, the better?

Of course, other readings are made during the test, such as temperature of water on and off ammonia condensers, on and off steam condensers, etc., and these readings are made frequently at regular intervals. While in the regular manipulation of plants this cannot well be done as frequently as during a test, still in too many cases it is almost entirely neglected. The manufacturer usually is entitled under his contract to a certain minimum amount of cooling water or a certain temperature, or its equivalent, and whether this "its equivalent" is really proper is another question. On the other hand, local conditions make this sometimes necessary in order to to have something to go by. If, for instance, well water at 56 degrees to 60 degrees F. is available, and the well pump gives out, or for any reason this supply stops, city water or river water of a much higher temperature may have to be used, with a consequent change in condenser pressure, or temperature of distilled water, for instance, in an ice making plant.

Leaving aside this consideration at present, how many operating men regard these temperature readings of sufficient importance to enter them into their daily logs, more frequently than possibly twice a day, and how often do they discuss these figures with their men, in order to improve the plant? Those who attended our last meeting in New York will remember the discussion in regard to superheat outside of compressor, and in which way this superheat affects the capacity quite seriously. How often is the temperature of the suction gas taken by the operating man, and if at all, is he in a position to draw the proper conclusions and provide remedies, if such are needed?

Plant Experience I.

I can give my own experience in a fairly large sized plant, where the operating engineer was as good a man as you can expect to find in such positions, and the owners were highly pleased with his efficiency; but at this very plant I found the ammonia suction gas superheated 31 degrees. The suction pipe was not covered, and the engineers were very careful not to let any frost get into the compressors, knowing that it caused leakage around stuffing boxes. In fact, they proposed to take the return first through a water cooling tank, in order to prevent frost. In the early days of ice-machine building, you will remember that one of the foremost builders had this return over the condensers for a similar purpose. This, however, was very quickly discontinued after the real effect upon the capacity of compressors was found. From the above, there is no question that if the thermometers had been used earlier the constant losses in capacity could have been avoided, or at least minimized. Let us assume for illustration that the compressor was 16 by 24 single acting, running at 78 r.p.m., with a back pressure 15.67:

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily tasks of the pattern shop, the foundry and core room. It is believed that your methods and devices, while good, may be improved, and thereby made more valuable if you publish them, so that other brains may work on them. We will provide the setting and pay you for the material. When your fellow tradesman puts the superstructure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

T_2=temperature corresponding to B. P.=0 deg. F.

V_2=Specific volume or volume of one pound=9 cu. ft.

Displacement of compressor in cu. ft. per minute=435.

Displacement divided by specific volume corresponding to B. P. equals 9, results in 435÷9=48.33 pounds, assuming 100% volumetric efficiency; that is, the pounds this compressor would deliver if there were no losses of any kind. Now, assuming a superheat of 31 degrees F. ammonia entering compressor at 31 degrees (instead of 0 degree corresponding to B. P.) the question is, how much less is our volumetric efficiency?

A table published at our last meeting in New York, shows that for each 1 degree F. increase of temperature and a B. P.=15.67 pounds gauge, the volume increased 0.022 cubic feet. Consequently, for 31 degrees F., 0.022×31=0.682. Therefore, our volume, instead of 9 cubic feet, occupied per pound of ammonia, will be 9.682 and the compressor will deliver 435÷3.682=44.8, a loss of 48.33—44.8=3.53 pounds; and, figuring 0.4 pounds per ton, 8.8 tons.

By having the suction pipe properly insulated, and regulating the flow of ammonia better to compressor, a good deal of this loss could have been avoided. The operating engineer in question is a man perfectly willing to be shown, and immediately gave proper instructions to his men, etc. Unquestionably there are many such cases, and the sooner the operating man learns to use the thermometer, the better for his employer, as well as the manufacturer.

Plant Experience II.

I can also mention a case of the other extreme. Here were two machines with two compressors, each manipulated in such a manner that a great amount of liquid was allowed to enter the latter. The compressors were frosted all over, and the discharge pipe was barely hand warm. The worst of it, however, was the fact that this liquid was taken direct from the ammonia liquid receiver in the engine room, forming, you may say, a short circuit, and interfering very seriously with obtaining results in cellars, and beer cooling on account of a rising back pressure up to about 45 pounds, even when the machines were running full speed. In this case, the operating man claimed he was so instructed by the manufacturer's erecting engineer. This, however, I doubt. He simply got things mixed up, and what the erecting engineer told him, most likely, was to allow a little ammonia to enter the compressor if it got too hot, not having any water jacket.

Discharge Temperature and Loss of Capacity.

Let us see whether we can ascertain the loss of capacity by using the discharge temperature. Assuming a condenser pressure of 185 pounds, which is usual under summer conditions, the discharge temperature of the gas taken from test record is about 240 degrees F. for 15 pounds back pressure. This temperature, however, was lowered to 100 degrees F. by injection of ammonia, which was lost to the refrigerating outfit.

Taking the same compressors as above, with a capacity of handling about 40 pounds of ammonia per minute, under 15 pounds B. P. (corresponding to an 82% efficiency), the loss would be 40÷2 (240—100)=sp. h. ($T—T_2$)=m.=2,800 B. T. U. per minute. If the average latent heat is 500 B. T. U., our loss would be 2,800÷500=5.6 pounds. As-

suming 0.4 pounds per minute, this loss amounts to 5.6÷0.4=14 tons. This latter instance is rather exceptional. Still, I have found several similar ones in vertical as well as horizontal machines. In the case just mentioned, it was a rather hard job to get the engineers to run with what they thought excessive discharge temperatures. In fact, when some oil on the outside of pipes began to smoke, they retired to an adjoining yard, leaving me in sole possession of the engine room, and watched me through a window at what they thought was a safe distance. However, they finally got accustomed to it, and are using thermometers now with very good results.

I do not mean to say that an operating man who does not use thermometers is on that account alone incompetent in the general sense of this term, but I do say that he would be more competent if he did use thermometers, since it teaches him relations existing between volumes and temperatures. I have also found, that, after getting used to this method, the engineer usually is very fond of it, and educates himself still further, and, in many cases, he is enabled to run the machines slower.

The Operating Engineer Requires Educating on the Question.

It is not easy to make this manipulating of compressors with the aid of thermometers general. It requires patience and work, but it will undoubtedly come to it, and the sooner the better. You will agree with me that it is easy enough to detect radical defects, such as broken valves, leaky pistons on account of packing rings breaking, cutting compressors, etc., sometimes with the aid of an indicator, sometimes without, but at best the indicator only shows whether any of the above defects exist, and whether there is an excessive clearance, and consequently re-expansion. It, of course, gives a chance to remedy these troubles, unless the general construction of the compressor prohibits it, but even if the indicator diagram does not show any plain defects, and if the compressor is in fairly good working condition, still the capacity may vary considerably according to how it is handled. It is in preventing these small continuous losses that the competent operating engineer can prove his value. Naturally, it will not do to simply tell him that he must run the compressors as close as possible to test conditions, which means in a manner to get the greatest capacity, and also the greatest economy. It is necessary to show him

In cases where tests have been made, the engineer naturally will learn a whole

open to be taught; but in the majority of cases no test ever is made, and the compressors may be run for years under faulty conditions of operating, and unless the proper instructions in that respect are made part of the engineer's daily routine, will continue to be so run. Quite naturally, an operating man cannot be expected to show the same results continuously as are shown in a test, where the manufacturer sends his test men, experts at their business, for as a matter of fact, making tests in the right way to protect the interests involved is quite an art in itself, as we all very well realize from a lot of former discussions on this particular subject.

Instructions to Operators.

Generally speaking, I believe more mistakes are made in allowing too much liquid to enter the compressor than the opposite; therefore, it is important to give the engineer some kind of a guide to prevent this, since in my opinion it is less detrimental to allow a very slight superheat than to flood the compressor. I therefore suggest giving the necessary instructions in table form as follows:

Gauge Pressure	Boiling Point	Temp. at which Suction Gas shall enter Comp.
12¼	— 5 deg.	+ 3 deg.
15.67	0 deg.	+ 7 deg.
19.46	+ 5 deg.	+11 deg.
23.64	10 deg.	+16 deg.
28.24	15 deg.	+20 deg.
33.25	20 deg.	+25 deg.
38.73	25 deg.	+28 deg.
44.72	30 deg.	+33 deg.

The idea is plain. If his gauge shows about 20 pounds back pressure, his thermometer on suction should show about +11 degrees F., etc. This table, of course, is not perfect; but if we all get together and compare notes, it should be feasible to make up a table which is nearly correct, and will at least give a man an idea how to handle his expansion to get best results.

If the suction gas is handled right the discharge will take care of itself. Since, however, I have found the knowledge as to what is a reasonable discharge temperature very hazy in the minds of operating men, who are not in the habit of making tests, I think it is necessary to give them also an idea of how these temperatures usually run. From various tests the following figures suggest themselves:

Back Pressure	Single Act'g Comp.	Double Act'g Comp
5	260 deg.	300 deg.
15	240 deg.	287 deg.
25	213 deg.	253 deg.

This is assuming cooling water of an initial temperature of 60 degrees F. For higher temperatures add the difference to the above figures, and for lower temperatures deduct the difference in temperature of water. This, also, is only an indication as to averages, but is sufficiently correct to give the operating man a clue as to what temperatures he may expect.

A Manufacturer's Duty.

As a matter of fact, the engineers of the manufacturers, especially of those having a test plant, are undoubtedly much more familiar with these figures than anybody else, and the object of these remarks is to get the manufacturers to give the operating man the benefit of their findings, and enable him thereby to run his plant more scientifically and more economically. They have already done a great deal, in giving us the data obtained by them at an enormous expense, and deserve our lasting gratitude therefor, and I feel sure they will also do all in their power to help the operating man, who very seldom has access to their data, or, if he has, only looks upon them as a conglomeration of figures, very nice, and possibly of some interest to college professors, but having no direct bearing whatever on his particular case. They have, however, a very direct bearing on his case, but he does not realize it, because probably it has not been put to him in the proper light; and therefore it is necessary to establish some tables with data easily understood, so that whether he understands the principles involved or not, he will be able to run his compressor in a more rational way than is often the case now, and make himself thereby not only more valuable to his employer, but also of help to the manufacturer.

Arthur D. Little, Boston, in discussing the value of chemistry when applied to power plant economy, says, that "Important as are the losses in the initial purchase of coal, they are small compared with those which attend its burning. Many a mill owner looks out of the window and sees, without knowing, his dividends go up the chimney. Under well regulated conditions of combustion the flue gases should contain not less than 12 per cent. of carbonic acid gas. They frequently contain no more than 3 per cent. This means that for every ton of coal burned under the latter conditions more than 52 tons of excess air are heated to the high temperature of the flue gases. Chemistry meets these conditions by analyzing the flue gases and regulating the draft as indicated by the percentage of carbonic acid found. At $2.25 per ton, which is much below the average price, the fuel bill of the United States was over $1,000,000,000 in 1910. Of that amount, chemistry could easily have saved $100,000,000.

PRACTICAL ARTICLES BY OUR READERS

Readers are invited to contribute to this Department with Short Articles and Personal Experiences—We pay for all Accepted Material.

INTERNAL COMBUSTION ENGINES.

By A. F. White.

A PRECEDING paper in the October issue dealt with and fully explained the cycle of the gas engine. The present article is confined to the fuels and their preparation for use in the cylinder of an internal combustion engine.

Forms and Classification of Fuel.

The most common forms of fuel used with internal combustion engines are as follows —City gas, producer gas, natural gas, gasoline, kerosene and crude oil. These fuels may be classed under three heads—solid, gaseous and liquid fuels.

Solid Fuels. — City and producer gas made from solid fuels which embody all kinds of coal, peat and wood.

Gaseous Fuel. — Natural gas, which nature supplies in many parts of the world. It is an ideal fuel for gas engines and, of course, is used almost exclusively in regions where it abounds.

Liquid Fuels.—Gasoline, kerosene and crude oil are the chief forms of liquid fuels used, the gasoline and kerosene being extracted from the crude oil by a process of distillation.

City Gas.

City Gas. — This, perhaps the most common form of gas, is evolved from bituminous coal when heated in air tight retorts. The volatile constituents of the coal are drawn out by being subjected to great heat, after which they are passed through various washing and purifying processes and stored in large reservoirs communicating with the mains laid throughout the streets of towns. City gas may contain a high percentage of what is known as water gas. This latter is made from anthracite coal or coke by an intermittent process. Air is first blown through a bed of fuel several feet thick until it is incandescent, the products of combustion being permitted to escape. A jet of steam is then blown through this incandescent fuel, which, being broken up into its constituent elements, gives out a rich form of producer gas. The passage of the steam quickly cools the gas, therefore the air has to be blown through again.

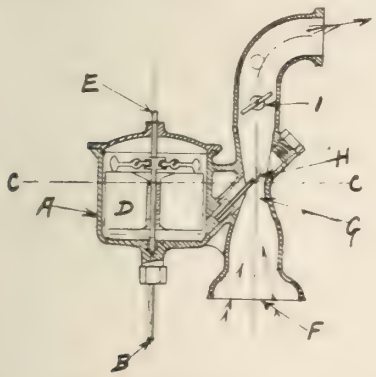


Fig. 2—Carburetor.

When the gas engine first came into use, during a period of years following Dr. Otto's practical achievement in 1876, city gas was chiefly used as an explosive agent. At present, although a great number of small engines are being worked by means of it, nearly all the large units are driven by producer gas.

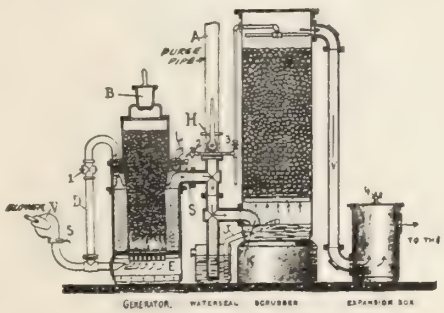


Fig. 1.—Suction gas producer plant.

Producer Gas.

Only a brief reference will be made to producer gas at this time, as it will form the subject of a complete article later.

For engines of about 30 h.p. or over, in regular operation, it is always more economical to use producer gas. A good example of a suction producer gas plant is shown in fig. 1. A fire is built on the grate and coal is added until the producer is full. An air blast is admitted during this period from a hand blower. The air mixes with the steam given off from the water below the grate, and passes through the bed of incandescent fuel, generating a combustible gas. This gas then passes through a cooling, scrubbing and drying process on its way to the engine. In starting up the producer, the waste gases pass into the atmosphere through the purge pipe. When the gas appears good at the test cock near the engine, the purge pipe cock is closed and the engine started up. The blower may next be stopped, as the generation of gas will proceed automatically by the suction caused by the engine.

Liquid Fuels—Gasoline.

Liquid fuels have to be brought into vapor form either before or on entering the engine cylinder. Gasoline is the most volatile form of liquid fuel and is the most easily vaporized, this latter condition being brought about by passing a current of air over or through the gasoline. The air is then charged with vapor and is said to be carburetted, the vessel, in which the process takes place, being known as a carburetor, a simple form of which is shown in fig. 2. The gasoline enters the chamber A by the pipe B, and is kept at a constant level at line CC by the float D, which operates the needle valve E. Air is drawn in at F and as the velocity increases at the neck G it becomes saturated with gasoline from the spray nozzle H, and passes on to the inlet valve on the engine. The amount is regulated by the butterfly valve, I.

Liquid Fuels—Kerosene and Crude Oil.

Kerosene or crude oils are used in oil engines. The cycle of operations, and the design and general structure of the engine may be the same for these oils as for all the other fuels already discussed, the only essential difference being an addition of devices for supplying the treatment and amount of compression. These oils have to be subjected to a high temperature in order to vaporize quickly, and different methods from those described for gasoline must be used. In the Diesel engine, the charge of oil is blown into the cylinder at the end of the compression stroke (the compression being 500 pounds per sq. in) in the form of a spray, by a small quantity of air compressed in a special compressor to about 550 pounds per sq. in. At this pressure, the temperature of the air being about 1000 F., ignites the oil,

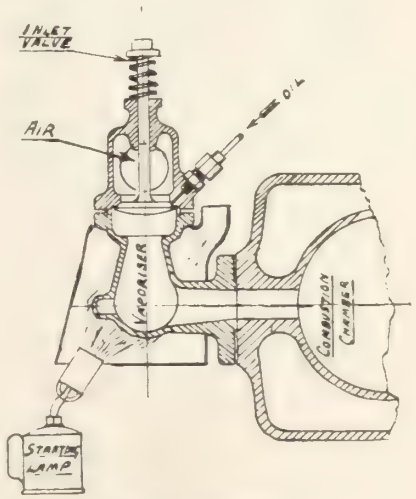


Fig. 3.—Vaporiser.

which expands and drives the piston forward.

A more common method of vaporization, and which gives good satisfaction for small-sized engines, is shown at fig. 3. The fuel enters the vaporizer together with the air, the vaporizer being kept at a dull red heat with the explosion. It is thus vaporized and exploded at the proper time, this being determined by the compression. To start this type of oil engine, a lamp or torch of some kind has to be used to heat up the vaporizer.

CARE OF GAUGE GLASSES.

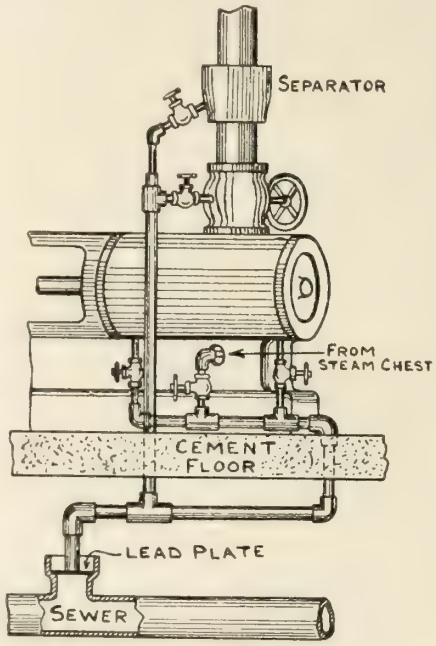
By Chester Adams.

IN the boiler room, the gauge glass often receives but scant attention. When one breaks, every engineer knows it is not a too comfortable matter to shut the valves leading to the glass and replace it. Spare glasses should always be kept on hand for just such emergencies, and in the keeping of these some care is called for. For instance, it is common to find spare glasses strung upon a wire, and unless a soft wire like copper be used, the glass, if moved much, is sure to be scratched, and lead, thereby, to early breakage. It is singular how sensitive the inner surface of a gauge glass is to injury of this sort; the slight friction of an iron or steel wire being sufficient to cause the glass to break from apparently no cause whatever. The experiment may be tried any time by rubbing the inner surface of a gauge glass with an iron wire and then placing the glass carefully away. In a majority of cases, it will be found that if the glass has not broken spontaneously in the course of time, its life, when in service, will be short. Another fault, to be found with gauge glasses in boiler rooms, is that they are set in such poor shape and so ill lighted that proper care is seldom vouchsafed to them. It is an easy matter to place an incandescent lamp near, so that it may be readily seen at all times; but too often nothing of the sort is provided and the gauge cannot be read with ease. This, coupled with possibly dirty conditions in the boiler room, soon obscures water in the glass altogether, so that it is easy for the fireman to make a mistake which may prove costly. If a gauge glass breaks, the fireman can bind up his arm and hand and close the lower valve without

FAULTY DRAIN PIPE ARRANGEMENT.

By William Welsh.

IN the electric power plant where I am working, it became necessary one day to start up a 50 h.p. high speed, piston valve engine and generator unit, to take the place of the motor-generator, and, although I took every precaution in opening-out, the piston was smashed, due to water in the cylinder. I was somewhat at a loss to know how it should have happened under the circumstances, and became convinced that the same thing might occur again, for it seems this engine had always given trouble in starting. Consequently, when the new piston was put in, I



Faulty drain pipe arrangement.

again tried my luck. Putting the engine in position to take steam, and keeping the throttle valve shut, I opened the valve on drain pipe from the separator and the engine started.

After digging up the cement floor, I found the condition of the drain pipes as shown in sketch. There was a piece of sheet lead lying across the opening into the sewer, which meant that the steam and the water from the separator passed around into the cylinder and steam chest when all the valves were open. Needless to say, the sheet lead was removed and the piping altered, so that separator and cylinder drains went to sewer by independent routes.

OPEN LETTER TO OPERATING ENGINEERS.

By W. A. Crockett, Sec'y. C.A.S.E.

REALIZING as I do what the C.A.S.E. has done to uplift and to make the engineering profession of this country better for those who have taken it for a livelihood, I am writing this letter to urge you, if not already a member of our association, to join it at once, as it has been stated time and again, that we cannot meet the conditions that confront us, without an organization which has the undivided support of engineers of all sections. Where there is unity there is strength, and it matters not how unimportant we are as units in a great profession, for we can still maintain this association, which already has accomplished so much.

The membership fee is so small in contrast to the returns realized, that we should not consider it at all. I truly hope that no engineer will hesitate to become a member of our association, and that each will act at once by sending to me for a charter. If we wish to make this association what it should be, we must give our help, time, attention and money, for, as you know, very little can be accomplished without the latter. For your own good, therefore, and for the profession as a whole, join the C.A.S.E., and do it now.

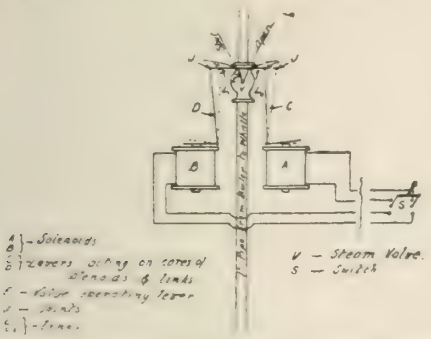
Do you know that the C.A.S.E. is the only means wherewith to get beneficial legislation that may affect your welfare? Do you know that they have a committee appointed to appear before the Minister of Agriculture on your behalf? Do you know that they run down and report all cases of violation of the laws, respecting engineers that are brought to their notice? I do not think that any engineer can say that the C.A.S.E. is not doing a great work, therefore, I would ask, what are you doing to help maintain it? Do not be a trailer, but be in the ranks with all of them. The association has done a vast amount of good which does not appear on the surface, and is becoming recognized and known well enough, to be of much more material benefit. You know in these matters it takes a great deal of preparatory work, and the results are not always apparent in the beginning, but I am certain that we can all, from our own individual experience, look back over the years and see many conditions, prevailing at one time, improved by the united action of engineers through this association. The direction of legislation has been one of the great things accomplished, and could not have been realized by an organization of less representation and importance.

As an organization, the C.A.S.E. has an influence that is, and will be, of still more effect, and will be able to get better recognition than most other similar institutions. The scope of our association reaches every section of this country, and its support and maintenance is up to each individual engineer; the benefits being in proportion to the interest taken. The writer has been identified with the association for many years, and has stood for its best interests always. He, therefore, appeals for your assistance, knowing that you will be well repaid for your interest in your fellow-man.

BLOWING THE WORKS WHISTLE.

By John E. Davies.

IN the accompanying illustration is shown a device for "blowing the works whistle" from the office. The steam pipe leading to the whistle must be brought to a convenient place in the wall. Using an inch pipe we connect to it an easy-working but steam-tight valve V, which will, with a turn of about 60 degrees, open full. A lever, E, is attached to valve V to operate same, and



Device for blowing the works whistle from office.

to this lever E are attached the links L1 and L2. These are connected to bell crank levers D and C, and are acted upon by the solenoids A and B.

In the illustration, the valve is shut. Closing the upper circuit through solenoid A, the core, becoming magnetized, attracts the short leg of the bell crank lever C, and moves the long leg, link L2 and lever E to the position shown by the dotted lines, thereby opening the valve V and blowing whistle. Further, link L1, and bell crank lever D, are put into the position shown by the dotted lines, thus lifting the short leg D off the core of solenoid B.

To close the valve, open the upper circuit and close the lower. This sends current through solenoid B and reverses the process. When valve is closed, open the switch S.

REPLIES TO READERS' QUERIES.

By J. H. W.

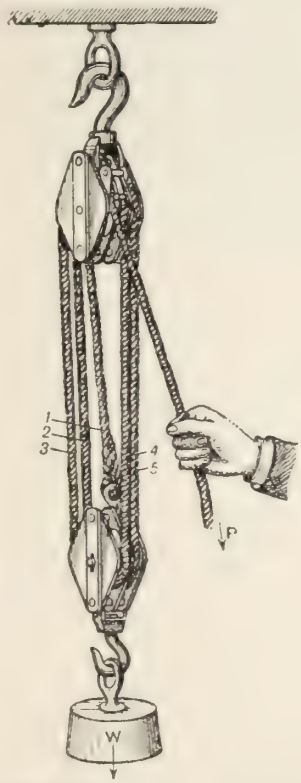
British Columbia asks:—What is the rule for finding the proper size of feed pump for a certain sized boiler or engine, say, for instance, a 950 h.p. engine, using 25 pounds of steam per horse power per hour?

Answer.—The engine uses 950×25= 23,750 pounds of steam per hour, and consequently the same weight of water. One imp. gallon of water weighs 10 lbs., therefore the nominal amount of water (in gallons) per hour is 2,375 gallons, and a pump should be purchased having a capacity of 75 per cent. to 100 per cent. more than this, in order to meet any extra demand.

Western Engineer query in the June issue of The Power House.—It recently became necessary to move some heavy machinery, and the question arose, were the ropes in the block strong enough for the purpose? Pocket books were of course consulted, then other questions arose. Did the becket rope get more load than others? How was the load distributed, and if not evenly, in what proportions on the various ropes? Argument raged and waxed hot all day, some holding that the load was evenly distributed, others that as the becket rope was not in motion, it therefore took the whole weight. It was even argued that with an evenly distributed load and given a sufficient number of pulleys to the sheaf, a ½-inch rope would lift anything. The text books did not say so. The even distribution man took on the job and accomplished it without accident, and claims the victory. I still have my doubts, therefore will some better informed reader give me the correct solution with explanation.

Answer.—The load is evenly distributed over all the ropes, the stress in each rope being the weight raised, divided by the number of ropes.

Let us assume that there are three pulleys in the upper block and two in the lower. As may be clearly seen in the



Western Engineer's rope block query and answer.

cut, the load W is supported by five ropes; hence, the tension in each rope due to the load is $\frac{W}{5}$. Neglecting friction and reckoning the rope to be perfectly flexible, so that no work is expended in bending round the pulleys, we see that the pull P necessary to overcome the resistance of W is $\frac{W}{5}$, for such a pull applied to the free end of the rope will be transmitted throughout it to the other end at the movable block. Thus, the effect of this pull, in overcoming the resistance of the load, is multiplied by the number of parts of the ropes which spring from the movable block, and calling this number N, we get

$$W = N \times P \text{ and } P = \frac{W}{N}.$$

It is quite true in theory that given a sufficient number of pulleys to the sheave, a ½-inch rope would lift any weight, but in practice, each additional pulley increases the frictional resistance to such an extent that a limit is soon reached.

ENGINEERS' CERTIFICATES—PROVINCE OF ALBERTA.

IN reply to query of L. J. Ellis, Hamilton, we understand that the holding of a stationary engineers' license for the Province of Ontario does not secure like privileges in Alberta, and that, therefore, an examination becomes necessary to qualify there. Until a uniformity of regulations prevails, engineers passing from one province to another will be put to this inconvenience. An opportunity for the executive of the C.A.S.E. to effect a more favorable arrangement seems to present itself.

ELEVATOR PROBLEM.

By A. G. Riddell.

I NOTICE in the October issue of The Power House an elevator problem by O. P. St. John, Toronto. To me, at first reading, the problem presents a fallacy, but on investigation, I have come to the conclusion shown by the following calculations:

1st. It is possible to assume that expansion of the air may be considered as isothermal, and the work done in expanding it, as given by the equation: $W = p.v. \log^e R.$, where w=work done, p=114.7 lbs. per sq. inch=16510 lbs. per sq. ft., v=110 cubic feet, and $\log^e R$=the Naperian logarithm of the volume ratios $\frac{110}{100}$.

This equation gives $w = 16510 \times 100 \times 0.094 = 115220$ ft. lbs. The work required to raise 1 ton (2000 lbs) through a height of 100 feet is 200,000 ft. lbs., therefore, if the accumulator be at the bottom of the elevator shaft, one ton cannot be raised through 100 feet, and the maximum total load, that can be raised through that distance, is 1152 lbs., assuming, of course, no work being done in

raising the 100-foot column of water.

If the cage be assumed to weigh 500 lbs. the work required to raise it through 100 feet would be 50,000 ft. lbs. The difference (1152—500)×100=62500 ft. lbs., has, therefore, to be accounted for.

It is easy to understand that the admission valve would necessarily need to be throttled away down, when raising the cage light. This causes "wire drawing" or "eddy" currents, and uses up the 62,500 ft. lbs. of energy. The phenomenon is one of unresisted expansion, wasteful of energy or power. Other opinions would be welcome.

AIR RECEIVER EXPLOSION.

By Fred. Nagle, Fort William.

THE Power House for October contains a reprint article from "The Colliery Guardian," London, England, relating to an air receiver explosion, attended with loss of life. Having had some experience with Rand air compressors while in charge of the power end for two years during the construction of the Loch Lomond tunnel, which conveys the water supply to the city of Fort William, I was much surprised to note, in reading the account given, that those in charge were so indifferent and careless in the matter of keeping the receiver clean. Just think of it—cleaning it out once in two years. Again, it surely should be well enough known by those who supervise and operate air compressors, that special oil is a requirement for the cylinders of these machines.

My judgment leads me to believe that the dirt and poor class of oil which was allowed to accumulate in this particular receiver, might easily cause internal ignition. Carelessness has much to do with most troubles and disasters. A chief engineer, under whom I once worked, told a fireman who had succeeded in knocking the water end out of the boiler feed pump, that it never happened before.

WHERE IS THE ADDITIONAL ENERGY EXERTED?

By William Welsh, Sulphide, Ont.

MY conclusions, regarding the question contained in the "Elevator Problem" article, by O. P. St.-John, in the October issue, are as follows: I maintain that the additional energy is exerted on the surface of the water in contact with the air in the accumulator, and water being to all intents and purposes, incompressible in practice, the energy must needs be stored in the body of contained air. This latter, when allowed to expand, generates kinetic energy, by meeting resistance, which in other words means that it gives up or exerts energy equal to the work done. As a consequence, lifting the car, with one ton weight aboard to the same height as reached by the empty car, is achieved by an additional amount of energy exerted equal to the increased resistance offered. The water occupies the same space between the water piston and the air at all times.

C. A. Pedley, Halifax, asks us to give results of paralleling two-600 volt, 60 cycle generators, the normal loads of the machines being 265 and 300 amperes. The larger runs at full load and the smaller runs 50 per cent. overloaded.

Answer.—The larger machine carries 300 amperes. The smaller machine carries $265 \times 1\frac{1}{2} = 397\frac{1}{2}$; therefore the total load on the two machines is $697\frac{1}{2}$ amperes, and the larger is delivering most current, although the exact proportion taken by each cannot be predetermined unless there is supplied more data than given above. The characteristics must be known.

If the characteristics are "not similar," the division is obtained by a complicated process that cannot be given here, but if "the machines have similar characteristics," they will divide the total load in proportion to their full load capacities, that is, the larger machine will take $\frac{300}{265+300} \times 697.5$ amperes and the smaller will take $\frac{265}{265+300} \times 697.5$ amperes. Such will, in all probability, be the case, as machines placed in any power house are usually made by the same firm, and being intended for parallel operations, their characteristics are similar. In the power house, the rheostats are usually adjusted so that the two machines in parallel carry the same percentage of overload.

Note on Characteristics.

The terminal voltage of a generator depends upon the amount of current it is delivering. Fig. 1 gives two typical curves showing the relation between terminal voltage and load. This curve is called the "characteristic" of the machine, and here it may be pointed out that some characteristics drop more than others. The characteristics of any two machines are said to be similar when the same fractional increase of load, applied to the machines, causes the same per cent. of voltage drop.—L. C. D.

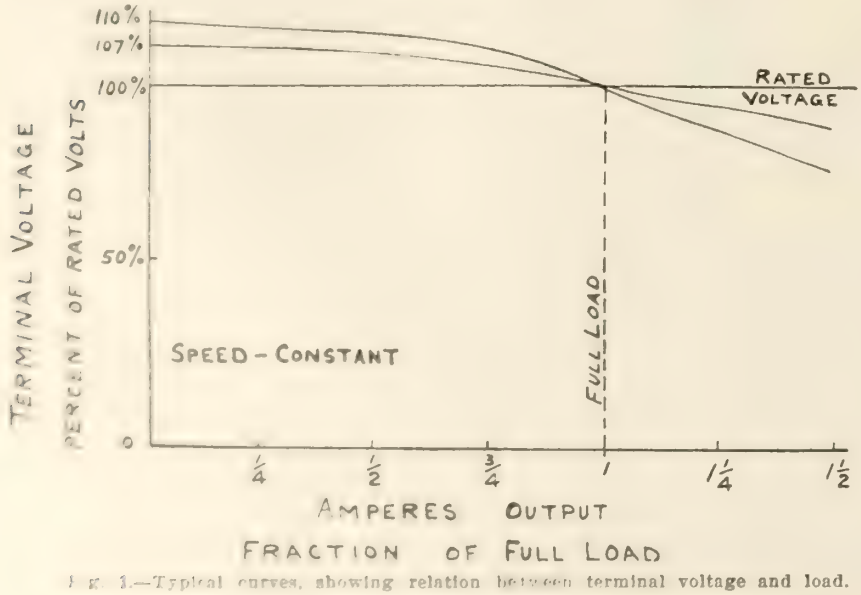


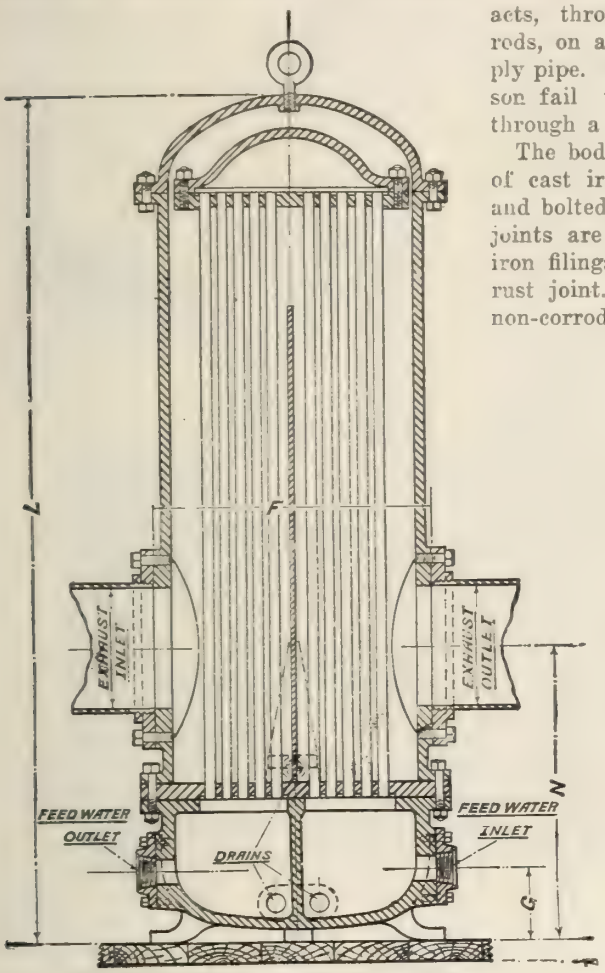
Fig. 1.—Typical curves, showing relation between terminal voltage and load.

THE ROBB FEED WATER HEATER.

THE shell of the Robb Feed Water Heater, is made of cast iron, except in the larger sizes, which are of steel. The tube plates and caps are of cast iron and the tubes of seamless drawn brass, thus making it practically indestructible. The tubes are expanded firmly in the upper and lower tube plates, the lower tube plate only being fastened to the heater body, leaving the upper tube plate free to expand and contract, thus preventing leakage of joints. This construction gives the greatest possible economy, durability, freedom from repairs and facility for thorough and rapid cleaning.

The water entering the inlet, passes slowly up through half the tubes on one side, and down through the remaining tubes on the other side. The exhaust steam enters on the opposite side from the feed water inlet, passing up one side of the baffle plate, and down the other. It will be seen, therefore, that the steam and water are moving in opposite directions, always bringing the hottest steam in contact with the hottest water and raising the temperature to the highest point just as it leaves the heater on its way to the boiler.

The impurities, that precipitate at about boiling temperature, are deposited at the bottom of the heater, where provision is made for blowing off and cleaning. The tubes and interior of the heater may be cleaned by simply removing the upper head and the cap of the upper water chamber, thus giving free access to inside and outside tubes.



The "Robb" feed water heater in section.

The drip in the bottom of the steam chamber provides for draining off condensation.

THE COCHRANE FEED WATER HEATER.

THE Cochrane Feed Water Heater is essentially a chamber in which exhaust steam and cold water are brought into actual contact. The steam enters through an oil separator bolted to the heater, while the water flows into a trough at the top, and then over and through a series of perforated trays, each catching the drip from the one above. Upon the efficiency of the oil separator mainly depends the success of an open heater. The exhaust steam flows in, around and between these trays, and comes into direct, actual contact with the water, so that the efficiency of heat transmission is not affected by dirt, sediment or scale, should such substances be present in the water. From the last tray the water falls into the settling chamber. This has a perforated false bottom carrying a filter bed. The boiler feed pump receives its supply from beneath this false bottom. The level of the water in the chamber is controlled by a hollow copper float which acts, through a system of levers and rods, on a valve in the cold water supply pipe. Should this float for any reason fail to act, the water escapes through a sealed overflow.

The body of the heater is constructed of cast iron plates re-inforced by ribs and bolted together at the corners. The joints are calked from the inside with iron filings and salammoniac, making a rust joint. The fittings are made of non-corrodible copper or bronze. The heater is either placed directly in the line of the exhaust steam pipe, to act as a "thoroughfare" heater, or it may "draw" the supply; that is, only part of the exhaust steam will flow into it. The heater may be arranged to receive the drips of heating systems and may be provided with an extra-large settling chamber to act as a storage tank. It may be provided with a float trap for the oil drips and overflow, so that it can be operated under back pressure or under partial vacuum.

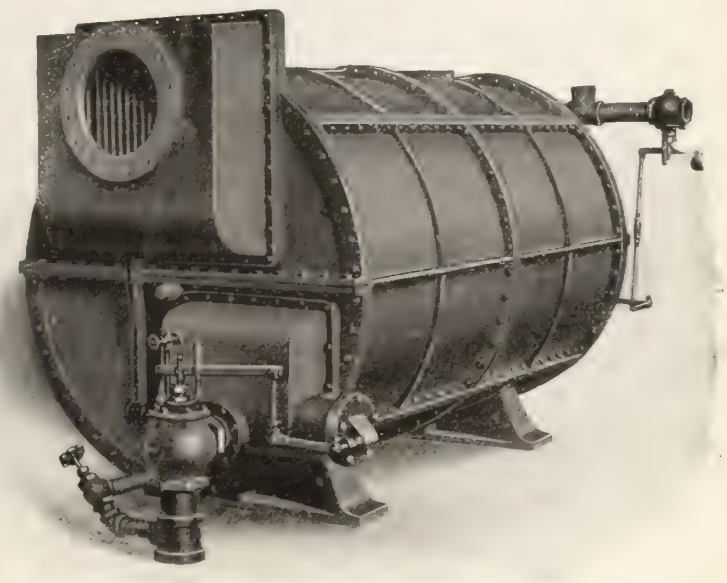
Cochrane Heaters are manufactured by the Harrison Safety Boiler Works, of Philadelphia, and are handled for trade throughout the Dominion, by the Canada Foundry Co., to whom we are indebted for this article.

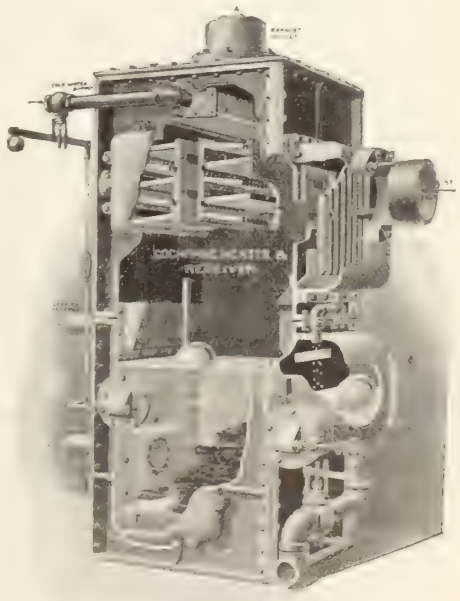
TO MAKE A WIPED JOINT.

In these days when many people find it necessary to do small repairs on automobiles and other appliances, it is frequently convenient to be able to make a wiped joint. To do so, melt the solder in a ladle, and pour it in the joint quite plentiful. Be careful not to pour it on your own knees. As the solder accumulates, wipe it into shape with a piece of canvas folded several times and greased with tallow. The canvas is also useful to hold the solder as it is poured upon the joint.

Every weld in a flue is a chance for a failure, because many times flues are slightly overheated at the weld and become quite thin just back of it.

The cost of fires each year is one-half the cost of all the new buildings erected in a year.


Cochrane horizontal cylindrical feed water heater and receiver.

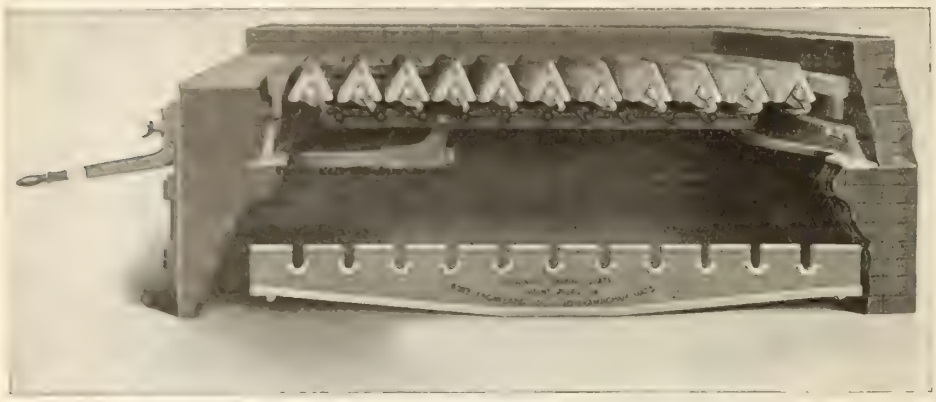

Interior view of "Cochrane" feed water heater and receiver.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

"MACDONALD" SHAKING GRATE.

THE "Macdonald" Shaking Grate, made by the Robb Engineering Co., Amherst, N.S., and South Framingham, Mass., is so designed that the tilting of the sections improves combustion by giving maximum irregularity of surface for breaking up clinker and the mass of unburned fuel, yet does not open up wide spaces which would allow unburned coal to fall into the ash pit. The detachable top sections may be changed easily for altering air openings or for renewal at minimum expense. When in operating position, the grate is flat, locked in place. The surface cannot be left uneven with points projecting into the fire for only when the grates are level can the lever be disengaged.

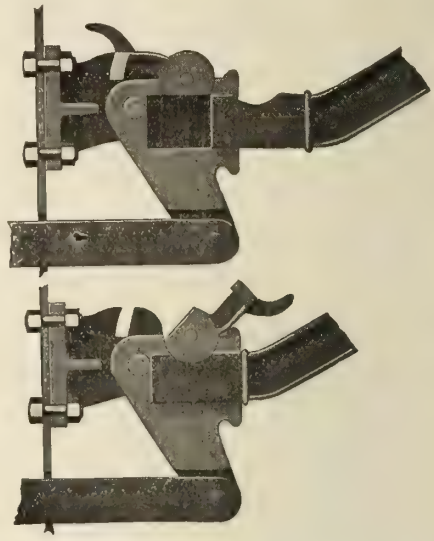


"Macdonald" shaking grate arrangement.

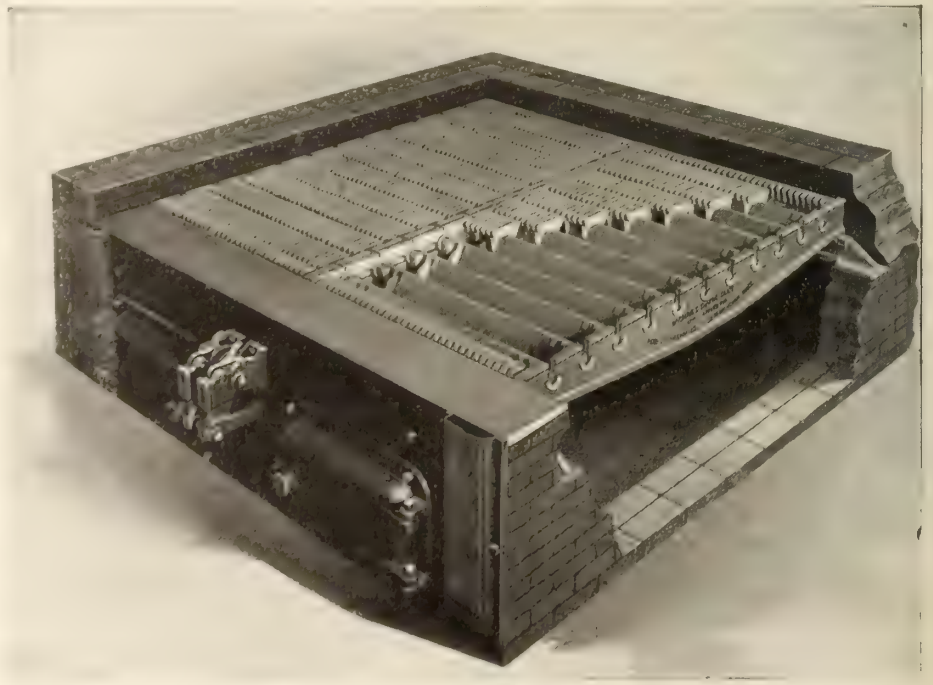
In some shaking grates the unevenness of surface when the rocking bars are operated is not sufficient to thoroughly break up the mass of unburned fuel; only a small portion of the lower ash surface being rasped off and deposited in the ash pit, consequently the fuel remains so solid that the air cannot properly reach it. To give greater irregularity of surface in the "Macdonald" grates the points of the triangles are made to penetrate deeply into the body of the fire. The mechanism is so arranged that when the lever is operated, the top surfaces of the sections are 60 degrees from the horizontal, and the lever can be swung through an arc of that amount. Because of the equilateral triangle construction of the sections and the fact that their tilting is entirely in one direction, the spaces are uniform throughout the grate.

The grates are made-up of small removable sections which securely fit the rocking bars. These can be furnished with any desired air space, and can be replaced, when advisable to change the grade of coal used, without altering the rocking and supporting bars or operating mechanism. If necessary, a few sections may be replaced without renewing the whole grate, should only a small part be burned out. This design, it is claimed, minimizes the cost of repairs and keeps the grates in good working condition.

The "Macdonald" grates are locked in a horizontal position and cannot be moved until the shaking lever is inserted and locked in place, which movement unlocks the grate. Unlocking the bell crank so that the grates may be shaken, locks the operating lever, and the only position in which the cam may be thrown down, so as to disengage the operating lever, is when the grates are level. These grates are adapted to any style of firebox, rectangular, circular, or the corrugated furnaces of internally-fired boilers.



"Macdonald" shaking grate locking device.



"Macdonald" shaking grate arrangement.

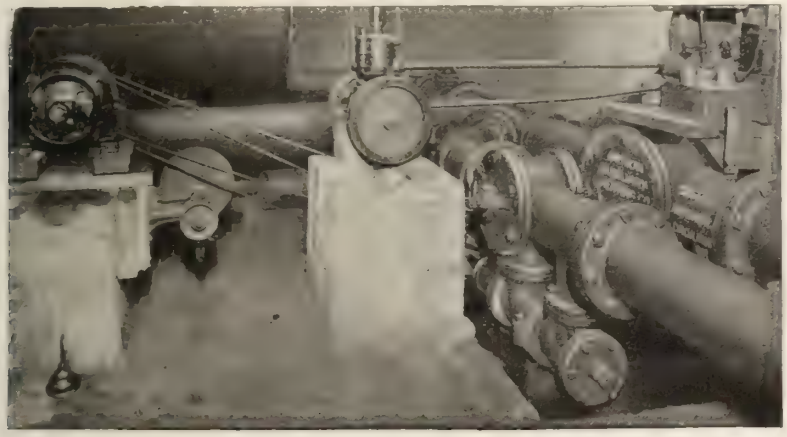
POSITIVE HOT WATER HEATING.

By C. T. R.

HOT water heating, as opposed to steam, has for a long time labored under one great disadvantage, namely, lack of flexibility. In many cases steam has received the preference in spite of its disadvantages because of the fact

that in general it is possible to get heat quickly by this means. Recently, however, hot water heating has been placed on an even footing with steam in this respect by means of a circulating device known as the Castle Automatic Circulator.

This consists of a small propeller set in the branch pipe, by-passed from the main return to the boiler and operated by a small electric motor. When ordinary gravity circulation suffices, the circulator is not operated, it being simply necessary to switch-off the motor to accomplish this. As soon as the propeller ceases revolving, an automatic valve cuts off the branch pipe and the water returning to the boiler travels along the main return pipe exactly as though the circulator were not attached to the system. As soon as it becomes necessary to hasten the circulation the motor is switched on, the propeller starts to revolve and the automatic valve takes up a new position, cutting off the main return pipe so that all the returns must necessarily go through the branch pipe and the propeller.



The "Castle" automatic circulator.

A particularly advantageous feature of this apparatus is the fact that there are no valves to be set, in fact, no attendance necessary beyond the mere starting and stopping of the motor. In many installations the motor switch is placed at some distance from the circulator itself, in any spot which may be within easy reach. In such a case it is not even necessary to go near the circulator to insure its prompt action when needed. Everyone who has ever operated a hot water system is well aware of the usual procedure in meeting a sudden cold snap. Coal must be piled into the furnace, the drafts opened to their widest in an endeavor to heat up a large body of cold water rapidly. Circulation depends entirely upon the difference in temperature between the supply lines and the returns, and opposed to the difference in head between the two sides of the system is the friction in long lines of pipes, fittings and valves.

It is not strange that under such conditions it takes a long time to obtain a proper amount of heat, especially as the very principle upon which gravity circulation is based means a low temperature of returns. This cold water must be heated many degrees in its passage through the heater if it is to do effective work in the radiators. The economy possible with the positive mechanical circulation is evident. By circulating the water rapidly the returns are but a few degrees lower in temperature than the supply lines, consequently less coal is used to heat them up again, while the rapid circulation insures the greatest possible efficiency of the radiating surfaces themselves.

The unsatisfactory results from hot water heating systems installed with piping of insufficient size or with many sharp angle turns are too well known to need more than passing comment. Efficiency in such a system is possible only by means of positive mechanical circulation, and the Castle circulator has proven so far to be a most satisfactory and economical method. This circulator is made in three sizes and is manufactured by the American Auxiliary Heating Company, of Boston, Mass.

"WOOSTER" BELTING.

"WOOSTER" belting, which is being introduced on the Canadian market by the Duryea Manufacturing Co., Montreal and New York, consists of selected cotton fibre woven into a solid belt and impregnated with the mineral product asphaltum. The manufacturers claim that their "Wooster" belting will stand satisfactorily a temperature of 200 degrees F., in addition to being water and acid proof. Further, due to a natural "tackiness," it is pointed out that drives operated by this product may be run with comparatively speaking, slack belts.

The initial stretch of "Wooster" belting, while perhaps somewhat greater than that of leather or rubber, expends itself quicker and thereby affords compensation. Belt laces applicable to other types will be found suitable. This belting may be used for either conveyor or transmission, and may be run either face next the pulley.

FACTORS INFLUENCING THE APPARENT DENSITY OF SMOKE.

Continued from page 308.

There is not time to discuss each of these in detail, but I may say that 1, 2, and 3, can be dealt with satisfactorily; 4, and 5, are probably sufficiently constant not to affect results seriously, excluding exceptional cases; 6 is the most difficult to deal with, and should be allowed for in making observations; 7 can be overcome, to a great extent, by keeping the angle which the line of vision makes with the horizon fairly constant; 8 would not, as a rule, be a serious obstacle, while 9 is not, I think, of great importance.

Arriving at a Standard.

Assuming, then, that we have decided on the method of measurement to be adopted, and on the type of standard to be fixed, the question remains, how is the standard to be arrived at? It would seem that this might be done best by the appointment of a technical committee, which would make observations over a certain period, say a year, of certain selected representative chimneys, where up-to-date and well-designed furnaces are installed, and bituminous coal is burnt. A consideration of the results of such observations, both as to smoke density and time of emission, should enable the committee to fix a fair and reasonable standard, both as to the density of the smoke, and the time during which such density should be permitted.

Time does not admit of a consideration of the reasons for and against the legal enforcement of a standard. There is not, however, much room for discussion, for the fact that a legally-enforced if unsatisfactory, standard has existed for thirty-six years proves that a standard is necessary, and that, to be of use, it must be legally enforceable. The present standard of "black smoke in such quantity as to be a nuisance" has utterly broken down, owing to the impossibility of proving to a magistrate's satisfaction that the smoke emitted was literally black. I have tried to show that it is now possible to fix a sound and workable standard for smoke emission, and to apply it in a practicable way.

CANADA'S WATER POWLR DEVELOPMENT.

The first inventory ever taken of the water powers of Canada has been com-

pleted by the Commission of Conservation, and the results embodied in a large and profusely illustrated report just issued. The investigation made by the commission, which has extended over a period of two years, shows that there is 1,016,521 horse power developed from water power in Canada.

The power situation in Ontario is treated very fully, special attention being given to the power possibilities at Niagara and the conditions affecting development there. Each of the power companies operating there, whether on the Canadian or American side, is described in detail. A significant reference is made to the granting of franchises to develop power at Niagara Falls. The report states that the low-water flow of the Niagara River would yield at the Falls, about 2,250,000 horse power, of which Canada's share (one-half) would be 1,125,000 horse power.

"Franchises have already been granted," it goes on to say, "and plants partially completed for the development on the Canadian side of the river of about 450,000 horse power. In other words, instead of 'millions' of horse power being available, as has been sometimes stated, it appears that nearly half, and by all odds the better portion, of Canada's usable share of Niagara Falls power has already been placed under private control."

PRESERVING NIAGARA'S SCENIC BEAUTY.

A novel scheme, to make the fall of water over the Canadian or Horseshoe Falls at Niagara more uniform, and to carry out in a measure the idea of the Conservation Commissions of Canada and the United States with respect to the diversion of the water over Niagara Falls for power development, was outlined by Mr. Isham Randolph, the Chicago engineer, in an address to the Engineers' Club of Toronto recently.

Mr. Randolph, who devised the novel scheme of building a dam of concrete blocks in a vertical position, and tipping the dam thus built into the Niagara River for power purposes five years ago, said that the Horseshoe Falls on the Canadian side had almost disappeared and had worn themselves into V form. The result was that the bed of the current was much lower than formerly, and the current itself was wearing the rock faster.

The commission of both countries concerned with the conservation of the natural beauty of the Falls, were agitated over the situation, and Mr. Randolph said that following the plan adopted. five years ago in damming the river some distance above the falls he thought of suspending two heavy steel cables across the brink of the V-shape, and from these cables to drop two strings of ten-ton concrete blocks into the middle of the powerful current just above the "V," thus checking its speed and tending to back up the water and distribute it over the rest of the brink. He said he had confided his scheme to President Taft, who expressed hearty approval, and was now negotiating with the Canadian Government concerning the matter. He said he had brought it before Sir Wilfrid Laurier's Government last winter, but with a new Government in power, he would have to begin all over again.

Mr. Randolph also gave an illustrated talk on the construction of the Chicago drainage and ship canal, relating interesting experiences with various corporations who were opposed to different phases of the great project.

In deliberating whether to continue the use of the isolated plant or to adopt central-service station, the engineer's earnings outside of his regular duties are usually overlooked. In many plants the engineer is the plumber, the steamfitter, the carpenter and the machinist, and when he is eliminated the odd jobs that fell to him will have to be paidfor atthe regular rates plus the shop owners.—Ex.

IMPERIAL Gas, Oil and Gasoline ENGINES

Have a World-wide Reputation.

NOW BEING USED IN

ALGIERS,	CANADA,	ITALY,	SOUTH AUSTRALIA,
ARGENTINA,	CHINA,	NEW SOUTH WALES,	SWEDEN,
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BELGIUM,	FRANCE,	PORTUGAL,	URUGUAY,
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WELL LIKED WHEREVER TESTED.

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CATALOGUES AND FULL SPECIFICATIONS.

Don't Allow YOUR Profits To Be Consumed By SCALE!

A Small Investment In A

Liberty Tube Cleaner

Will Bring Surprising Results

This cleaner can be easily operated by air or steam and is guaranteed to remove all scale rapidly and will prevent accidents through tubes burning out.

Perhaps your boiler is coated with scale. If it is, think of the unnecessary fuel this boiler must have consumed, then compare this cost with the cost of a Liberty Tube Cleaner—the certain saving will appeal to you.

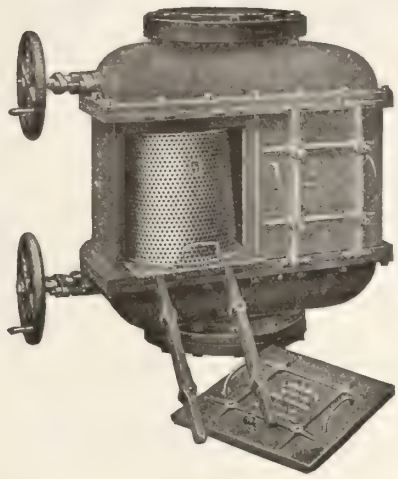
Your inquiries will be greatly appreciated.

Liberty Mfg. Co.

6902 Susquehanna Street

PITTSBURG, - - PENNA

The Liberty Twin Strainer.



Protect Your Valves and Injectors

From untold damage caused through foreign matter that inhabits your feed waters, by installing

"Twin" Strainer

It has been invented to do away with this great feed water evil and performs its functions perfectly.

Either side can be easily cleaned separately, giving an uninterrupted flow of water.

Give the Twin Strainer a trial and note the trouble you save---if unsatisfactory it will cost you nothing.

Write at Once.

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Don't fail to mention this paper in writing to advertisers.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

BRITISH COLUMBIA.

Stave Falls.—The Western Canada Power Company, Ltd., have completed the installation of two units, or 10,000 kw. each, here. The first unit will be in operation by Nov. 15.

Victoria.—The pumps which recently arrived from Manchester, England, to replace those manufactured by the D'Olier Engineering Co., Philadelphia, for the salt water high pressure systems, which latter pumps were rejected by the city because they failed to come up to requirements, will be installed in the near future. The steam unit has been placed and is in working order, having, on preliminary tests, come up to the specifications. The electric unit is now in course of installation. The new pumps will each be capable of delivering 2,500 gallons per minute at a pressure of 150 pounds. The old engines are now lying on the wharf at the electric lighting plant and agents of the D'Olier Engineering Co. are endeavoring to dispose of them.

ALBERTA.

Edmonton.—The city will purchase a surface condenser for the power plant, on the recommendation made before the council by the chief engineer, A. J. Latornell. It was agreed that specifications should be drawn, and tenders asked for supplying the condenser. This machinery will cost in the neighborhood of $5,000.

SASKATCHEWAN.

Regina.—Steps are being taken towards the establishment of a municipal gas plant in Regina, and it is confidently expected that before another year goes by there will be such a public utility here. The city already owns waterworks, electric light and street railway utilities and these are such a success financially that the movement is now being towards establishment of a gas plant.

Moose Jaw.—Tenders will be received until Monday, December 4th, 1911, in the Council Chamber, Moose Jaw, Sask., for supplying the fire department of the city with one pumping engine, having a capacity of 800-850 gallons per minute. Tenders are invited for motor-driven pumping engines, motor propelled steam pumping engines, or horse-drawn steam pumping engines. W. F. Heal, City Clerk.

MANITOBA.

Neepawa.—Tenders will be received until Friday, December 15, 1911, for the following works:—

Contract A.—Labor for laying water pipes and sewers.
" B.—Pump house and filter room.
" C.—Water tower.
" D.—Cast-iron water pipes.
" E.—Gate valves, fire hydrants, etc.
" F.—Mechanical filters.
" G.—Pumping machinery.
" H.—Dam, intake, and reservoir.
" M.—Wooden stave pipes.
" S.—Sewer pipes.
" W.—Laying conduit.
" X.—Sewage disposal works.

Plans, specifications, etc., may be seen at the Town Hall, Neepawa, or at engineers' offices, Winnipeg and Toronto. W. H. Gossel, mayor; R. H. Fusee, chairman; J. W. Bradley, secretary-treasurer; Chipman & Power, engineers.

ONTARIO.

Fort William.—The Canada Iron Corporation will erect a gas plant in connection with its works; estimated cost $50,000.

Ottawa.—The E. B. Eddy Co. has decided to make some very expensive improvements to its present plant at its Chaudiere Falls. Engineers have been preparing plans for the last two months, by which the company will secure double the power that it now uses, and this, with the same amount of water. It is said that the new machinery purchased is in the vicinity of a half million dollars.

Ottawa.—The Canadian Pacific Railway Co. has opened negotiations with the mines branch of the Government to purchase its testing plant plant at Alfred, Ontario. The company hopes to continue the industry on a commercial basis and supply the city of Montreal in particular with peat fuel. It recognizes the success of the Government experiments as incontrovertible proof that the peat production in Canada has now become a commercial enterprise of much importance.

Windsor.—By the gas merger which has just been completed in Cleveland, the control of the entire natural gas business in western Ontario passes into the hands of Buffalo and Canadian interests. The consolidation represents a capital of $3,000,000. The companies which have united are the United Fuel Supply Co., the Ridgetown Fuel Supply Co., the Northern Pipe Line Co. and the Volcanic Oil & Gas Co. In the first three companies the largest stockholders are Buffalo men, headed by Philip Roth, R. L. Pattinson, P. A. Little, L. B. Willet and W. C. Barker, who have bought out interests of former Ohio stockholders. The Volcanic Co., headed by D. A. Coste, is the company from which the Windsor Gas Co. secures its supply. The new organization will control franchises which have already been secured from about twenty cities and towns in western Ontario, including Windsor, Chatham, Sarnia, Wallaceburg, Essex, Ridgetown and Blenheim.

Berlin.—The contract for the new street lighting of the City of Berlin, was awarded to the firm of A. H. W. Joyner, 76 Bay St., Toronto. It includes: 10 Helios C. C. Regulators, switchboard equipment for same, and 1,500 series fixtures complete with sockets and brackets.

QUEBEC.

Bromptonville.—The Tobin Mfg. Co. are arranging to put in another steam engine of 250 horse power. Owing to several new machines having been placed in the annex recently built, the present power is found to be inadequate. Another boiler will also be installed. When completed, the capacity of the plant will be 400 horse power.

Point Claire.—This municipality intends to build drains, waterworks and electric light. Tiles, iron pipe, engine and boiler, pump, dynamos, hydrants, hose, etc., will be required.

Upton.—This municipality is planning the construction of drains, waterworks and electric light plant. Tiles, iron pipes, engine and boiler pump, dynamos, hydrants, hose, etc., will be required.

Lake Megantic.—The Lake Megantic Pulp Co. will build a dam on the River Chaudiere to develop 1,500 h.p. Turbines will be required.

NOVA SCOTIA.

Dartmouth.—It is reported that the property of the Dartmouth Electric Light Co., owned by the Royal Securities Co., will pass into the possession of the Nova Scotia Power Co., whose plant will be on the Mersey river, eighty miles from Halifax.

CATALOGUES.

The Positive Clutch and Pulley Works, Ltd., Toronto, have just issued a new catalogue—the second in twelve months. This is significant of the rapidly increasing range of their products and the large demand for same. The firm's positive combined jaw and friction clutch is fully described and illustrated, as well as their splitwood rim pulleys with steel centres. A full line of transmission appliances is also manufactured. The catalogue contains numerous useful engineering tables, and should be on the fyle of every superintendent and millright.

Veritys, Ltd., Aston, Birmingham, England, have sent us a circular descriptive of their Radiant Lanterns for tungsten and carbon lamps which are suitable for indoor or outdoor use. Prices are quoted in Canadian currency.

The American Steam Pump Co., Battle Creek, Mich., who manufacture the Marsh and American lines of pumping machinery, have just issued a 188 page catalogue which they will be glad to send to anyone interested in pumping machinery.

BOOK REVIEWS.

Bearings and their lubrication, by L. P. Alford, M.E., New York, and the McGraw-Hill Book Co., $2.50 net. This book aims to present the underlying principles involved in the design of all classes of machinery bearings. A wide field is covered and numerous examples are given together with tables compiled from various sources, both American and European. The laws of friction are so imperfectly understood that a book like the present, which tabulates the results of numerous careful experiments, will be of great use to all designers of machinery and transmission appliances.

TRADE NOTES.

The adoption of Vulcan Soot Cleaners by the various Canadian railroads is increasing day by day, and the most recent installation projected is that in the new C.P.R. power house at the Windsor Street station, Montreal, where three 400 H.P. Babcock & Wilcox boilers will be equipped. Cleaners are also being installed on the boilers at the Stratford shops of the G.T.R. and the American Company are completely equipping the G.T.R. power station at Battle Creek, Mich. Besides these, the G.T.R. have given 7 orders during the last twelve months. The new power house of the Wayagamack Pulp and Paper Co. which complete installation is in the hands of the Waterous Engine Works, will have five cleaners. The municipal Water Works, of Arnprior and Lachine have also adopted them, as well as the Montreal Paper Mills, the B. Greening Wire Co., the Montreal Gazette, and the Montreal General Hospital. The latter has just had six cleaners installed. The Vulcan Cleaner is adapted to fire or water tube boilers, either vertical or horizontal, and consists of a movable blow pipe containing a nozzle which throws jets of high pressure steam into every tube and blowing with the draft removes the soot.

Jones & Glassco, Nicholas Building, Montreal, advise us that their principals, Hans Renold, Ltd., Manchester, England, manufacturers of Steel Driving Chains, have been awarded the Grand Prix at Turin, Italy, in four classes—these being for their Chains for Engineering, Cycle, Motor-cycle, and Motor Vehicle work.

Laurie & Lamb, Montreal, are supplying 2 small Belliss & Morcom Compound Engines for the new jail, Montreal; also one 2,000 k.w. Turbo-alternator to the Saraguay Electric Co., for their power house at Cartierville; a condesing plant is also included in the latter contract. The turbine will be Belliss & Morcom make, and the alternator that of the Swedish General Electric Co.

The main offices of **A. Eugene Michel and Staff, Advertising Engineers,** have been moved into the Park Row Building, 21 Park Row, New York, where larger space has been secured, as necessitated by constantly increasing business.

Jones & Glassco, Nicholas Building, Montreal, inform us that their principals, Watson Laidlaw & Co., Glasgow, have been awarded one Grand Prize, one Diploma of Honor and two Gold Medals for their Centrifugal, Hydro-Extractors and Cream Separators, at the Turin Exhibition, Italy. The installation which received the Grand Prize was the one in which an electrically-driven, a water-driven and a belt-driven machine were erected on the same framing for comparison of the three systems. The Diploma of Honor was awarded to the Hydro-Extractor method of driving Centrifugals. The Gold Medal was awarded to the Hydro-Extractor exhibited, and the Princess Cream Separator secured the other Gold Medal.

The Robb Engineering Co., Amherst, N.S., have recently sold heating boilers to the following companies: C. C. Young Co., Winnipeg, Man.; John Plaxton Co., Winnipeg, Man.; H. G. Hagen & Co., Amherst, N.S.; Gorman, Clancy & Grindley, Edmonton, Alta.; and R. C. Thomas & Co., Calgary, Alta.

The Robb Engineering Co., Amherst, N.S.—Owing to the rapid increase of business, since taking over the Silliker plant, the Nova Scotia Car Works, Halifax, has found it necessary to duplicate its power plant. The original plant was supplied by The Robb Engineering Co., and the duplicate order has been placed with the same concern. The new installation will consist of a 600-horse power Corliss engine for direct connection to electric generator, three 200 horse power return tubular boilers with self-supporting steel smoke stack five feet diameter, ninety feet high. Feed-water heater, piping and other accessories, form also part of the contract.

The American Blower Co., Detroit, Mich., with factory also at Troy, New York, and branch offices throughout the world, have come to realize the importance of the Dominion of Canada, as evidenced by the charter ap-

plication just filed, for a Company to be known as the **Canadian Sirocco Co., Ltd., of Windsor, Ontario.** This Company has acquired from the City of Windsor, a tract of land, centrally located, comprising about 4½ acres, situated on the Essex Terminal Railway, and will proceed at once with the erection of a plant which, when completed, will doubtless be one of the most complete of its kind on this continent. Work is to proceed at once on the construction of the Erecting Shop, 50x200 feet, which will be of steel and concrete construction, also the office building. This is about all that it seems possible to complete for occupancy this winter. In all probability, the foundry building will come next, and be started in the spring. The company will hold the exclusive patent rights for the manufacture in Canada of the famous "Sirocco" fans and blowers which have revolutionized the blower business of the world by their space and power-saving features. These patents are controlled in the United States, the U.S. possessions, Mexico, Central and South America and Japan, by the American Blower Co., and in Europe by Davidson & Co., Sirocco Engineering Works, Belfast, Ireland, home of S. C. Davidson, the Inventor.

Sirocco fans are being largely specified and used throughout the world for mechanical draft on boilers, mine ventilation, heating and ventilating plants, for public buildings, school houses, factories, stores and in the British Navy. The Canadian Sirocco Co. will also manufacture the full line of the American Blower Co. products, consisting of fans, blowers, heating, ventilating, drying apparatus, steam engines, steam traps, etc. The Canadian Sirocco Co. enters the Dominion of Canada with the complete Engineering staff of The American Blower Co. at its disposal. The City of Windsor has been fortunate in securing this important industry.

To the Readers of "THE POWER HOUSE"

On page 60, September edition of The Power House appeared one of the greatest offers yet offered to its readers. Read the advertisement mentioned, and then carefully consider this offer. Subscribers to

Twenty Century Mechanics

are wanted, and SATISFIED SUBSCRIBERS above everything else, therefore I personally agree to refund your money if, after receiving the Twenty Century Mechanics for one year, you feel you did not get value received. I have faith in you—that is why I make this offer. Also, I know that Twenty Century Mechanics will exceed your expectations, and for that reason I can afford to make the above offer. You are to be judge; your word is final, and I hope you will SUBSCRIBE AT ONCE. The Subscription is ONLY $1 per year. Address,

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Canadian Agent Wanted

for patent flexible metallic faced packing.

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Wooster Cotton Belting
for both Transmission and Conveying Purposes.

What do these Facts Mean to You?

(*1.*) Wooster Belting has recently replaced leather and other textile belting in many of the largest establishments in Canada. (*2.*) A solid woven belt, even tension, and durable. (*3.*) Not affected by moisture or chemicals. (*4.*) Our Patent Rights allow *no one else* to treat a belt with asphaltum. (*5.*) Absolutely no slip.

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Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,
—FOR—
MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys,
Solid and Split
Sprockets,
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This isn't a catalogue — it is a 50-page book on lubrication. It contains the best and most interesting information on this subject ever gotten together: just the kind of data all progressive engineers are looking for. It tells all about the automatic lubrication of power plant machinery, how oiling systems should be installed and describes all the apparatus necessary, including oil filters, sight feed oilers, gas engine lubricators and many other things we haven't room to tell about here. The chapter on the "Nature, Choice and Testing of Oils" explains fully how to select the oil best suited to any kind of lubrication

Ask for Book 'C"-55, "Scientific Lubrication of Machinery," and it will be sent you by return mail. Do it this very minute or you might forget.

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Largest Exclusive Manufacturers of Oiling Devices

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34

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of the water temperature in your hot water boiler is a

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to your boiler and to your fuel pile.

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not connect a Thermostat to your hot water boiler so that your steam boiler will reap the benefit? Any of our thermostats now in use cannot be purchased at four times the original cost.

WHY ?

Because they are saving the original cost, at short intervals, all the time actually earning money every minute for the owner, Ask for price installed with guarantee.

Write or call.

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HAVE YOU WRITTEN for a Free Half-pound Bar of Stephenson Bar Belt Dressing? This bar is large enough to give a convincing trial and is often an introduction to initial orders. After the first order the others follow as a matter of course.

The genuine Stephenson Bar Belt Dressing always bears this trade mark:

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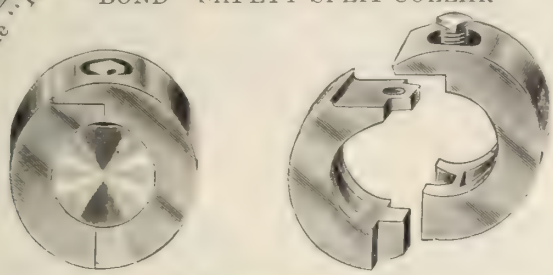
"BOND" SAFETY SPLIT COLLAR



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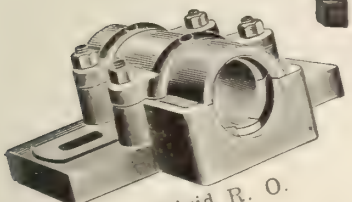

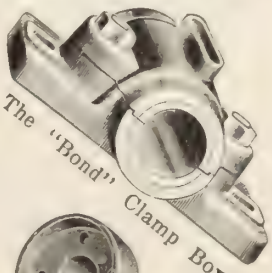

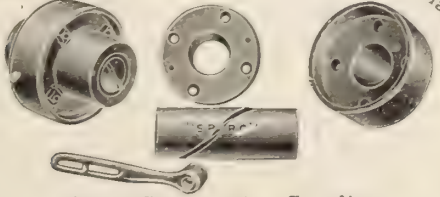

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CANADIAN BOND HANGER & COUPLING CO., Limited

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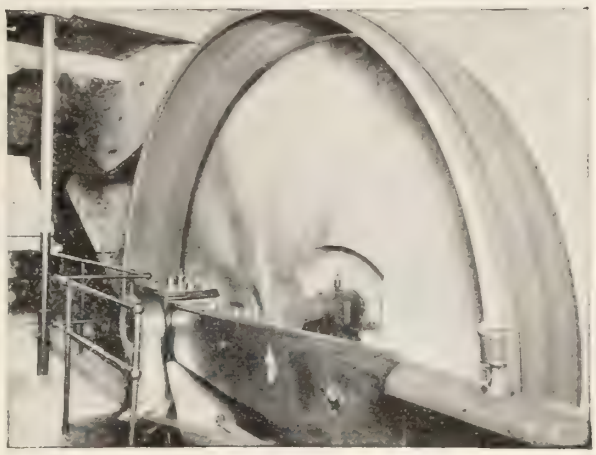

1628 lbs. Constant Pull without slip. Only Cling-Surface treatment permits this.

The belt, 18 in. double leather, shown runs at 3,036 feet per minute and carries 150 h.p. from a 14-ft. driver to a 42-in. wood pulley. Distance between centres 23 ft. The picture was taken when pulling full load. There was no sign of slipping. Pretty good with 3 ft. 4½ in. slack, isn't it? But slackness without slip isn't the only good resulting from Cling-Surface treatment. See what the owner says:

"We have been using Cling-Surface for eight years with most satisfactory results on all sizes of belts and kinds of drives. When judiciously used it lessens tensions and increases efficiency, as well as period of usefulness."—H. H. Reid, Secy. T. S. Simms & Co., Ltd., St. John, N.B., Canada.

Cling-Surface produces remarkable results like this without, as is sometimes supposed, making the belt sticky. Stickiness is almost as bad as slipping, and may peel the surface fibre off the belt. Cling-Surface makes a belt do its work **naturally**, because it brings the belt fibres, internal and surface, back to their natural softness and flexibility. The contact becomes like that of a moist hand and no lumps collect between pulley and belt faces. Dry belts pulled up tight are not in natural contact. This is the whole secret of the success of Cling-Surface belts. It is not a surface treatment; it is applied to the surface only because the belt's interior can be reached in no other way. Any belt food must get **into** the belt to create the desired flexibility.

Treat just one of your belts with Cling-Surface—note the improvement—we won't have to tell you to treat the rest. Cling-Surface is a money-saver. All users know this just the same as the people mentioned above who have used it for eight years. Get our literature and give Cling-Surface a trial.

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Water or Steam Cannot Affect the Efficiency of "AMPHIBIA"

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—Leather Belting—

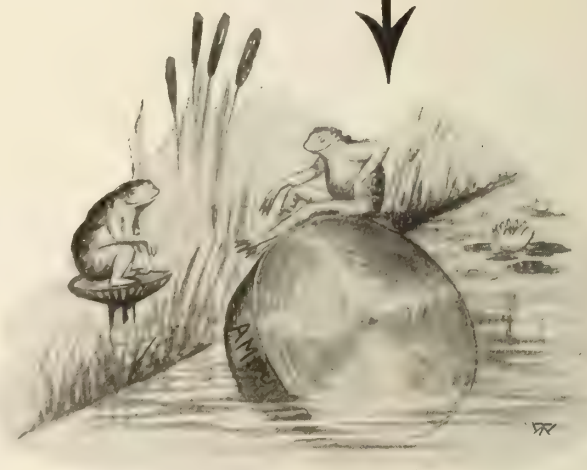
HAVING everything under our own supervision from the hide to the finished belt, we are able to offer YOU a Waterproof Leather Belting that we can fully guarantee to meet your requirements under all conditions of weather.

It is impossible for "AMPHIBIA" to stretch or come apart when wet, and it will withstand more hard usage than any ordinary belting made.

"Seize This Opportunity"

We will send to any responsible firm one "AMPHIBIA" Belt on trial, and if it fails to do as as we state, it can be returned, and there will be no charge made.

Let us hear from you at once. We have "AMPHIBIA" Belting for every purpose.



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If so, look into the PAST RECORD of

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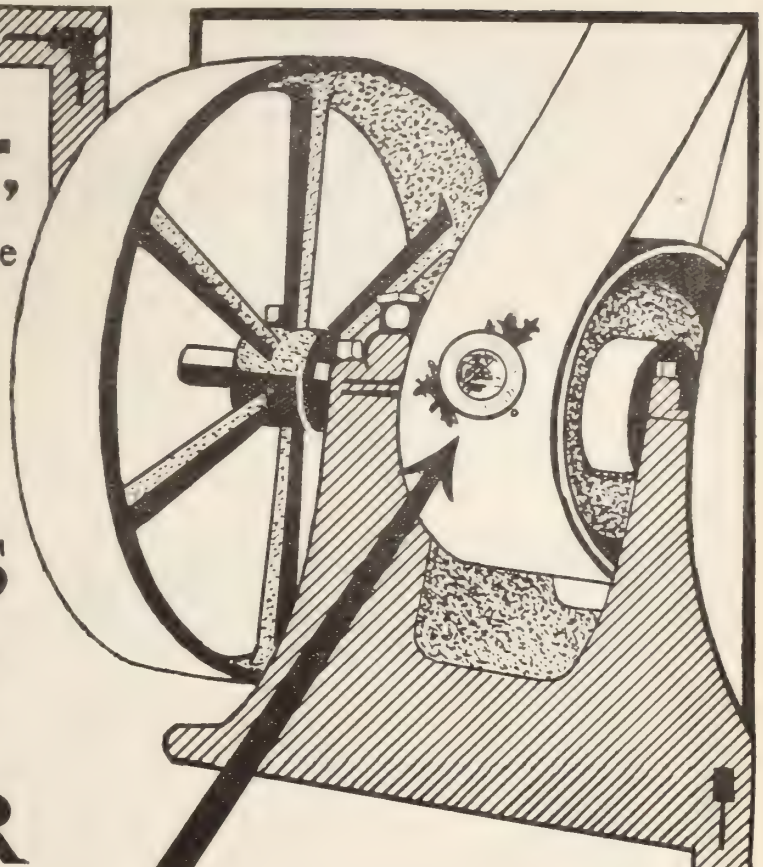

by writing us for testimonials. These testimonials are written by firms throughout the country who are enthusiastic over the service and economy of our belting. An investigation will prove valuable to you.

Let us hear from you at once.

The quality of D. K. McLaren's Belting is due to the work of experts who select the best centres of the hides and put them through a tanning process known as the Genuine British Oak-Tanned Method—a method that has caused many imitations but no equals.

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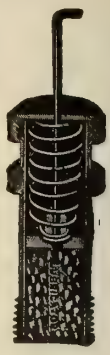

when you use our lubricators. No dripping and dirt. Works only when machinery is in motion. Write us about lubrication.

Our system is economical

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Save Your FUEL!

Decrease your fuel bills and increase your boiler efficiency by removing all scale with

WALKER'S ELECTRIC BOILER COMPOUND

We guarantee that this compound will eradicate ALL scale, and, if used regularly, will keep your boilers absolutely free from scale without the slightest injury to the boilers or pumps.

MR. ENGINEER, if you are interested in cutting down fuel costs write us at once.

The Electric Boiler Compound Co.
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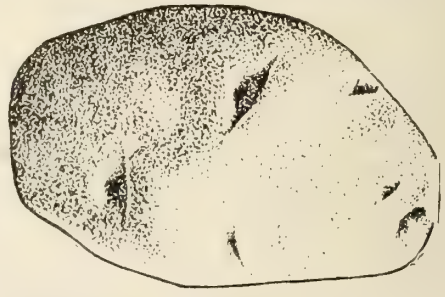
Let Us Demonstrate The True Value of Our

Potato Scale Boiler Cleanser

by sending you a quantity on free trial—it will cost you nothing if unsatisfactory.

We guarantee that this feed water treatment will remove all scale from your boilers without the slightest injury to tubes, shell or connections, and that it will prevent foaming and other boiler troubles due to impurities in the feed water.

SEND ALONG A GALLON OF FEED WATER FOR ANALYSIS, AND WE WILL FILL YOUR REQUIREMENTS.



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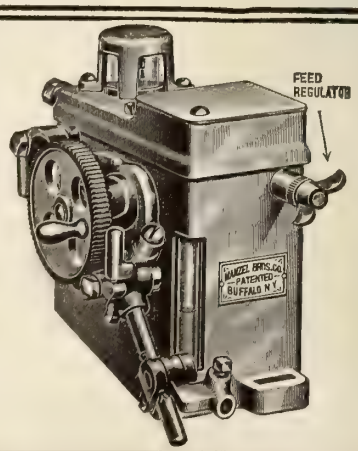
30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.



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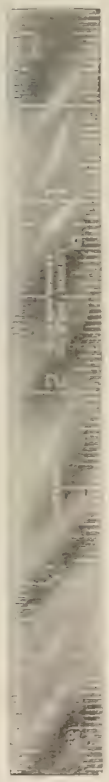
They are both made by first-class mechanics, and are articles that every Engineer should have.



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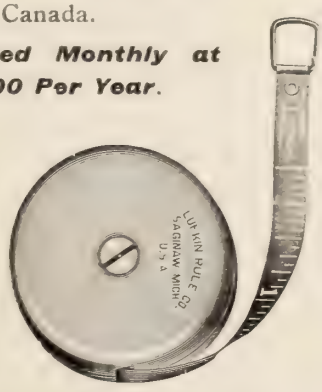

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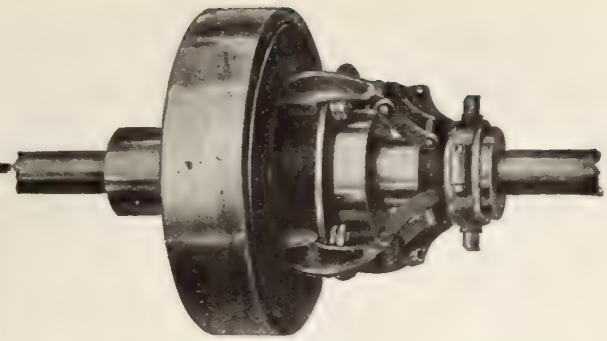

The Stepping Stone

Scientific Management in the manufacturing departments demands that wastes of all kinds be eliminated, and the scrutiny for possible leaks needs to be turned no more thoroughly than in the direction of the equipment itself which fashions the product. Progressive superintendents and managers are ever on the alert for new developments in the types of machines and appliances used in their shops, and particularly are they anxious to discover improvements in which the economy factor is evident.

Oftentimes, however, their attention is wholly concentrated on what readily appears to them to be the big wastes. If a decided improvement on some large piece of machinery is announced, they investigate it at once ; and if in comparison they are satisfied that their old machine has become so obsolete it is costing them money to keep it, it is immediately scrapped in favor of the modern machine.

Yet, as to what really constitutes a big waste is where Scientific Management enters. The Stepping Stone between failure and success generally lies in the discernment of big wastes, hidden so as to diminish their grim proportions. The power traveling along your line shafting is unseen, but you know how many dollars a year you burn to make it. Because you know it saves greatly in this expenditure, you have clutches on your shafting for group control and distribution of the power.

Now, follow a little farther. When it is evident that in distributing this power with POSITIVE Combined Jaw and Friction Clutches, none, absolutely none, of it will be wasted, don't they merit your consideration? The POSITIVE Clutch has the flexibility of any clutch, because the frictions start the load until the speeds are synchronized ; then the jaws fly in and transmit all the power all the time, because jaws can't slip. If you are using old-fashioned friction clutches, here's a chance to eliminate a big waste, and you can't realize what a large saving it means until you try the POSITIVE Clutch. Perhaps it's the very Stepping Stone you need in your plant.

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DO YOUR PROFITS GO—

—Into the BANK or for EXTRA FUEL BILLS?

Mr. Manufacturer,—They should go to the bank, but perhaps they are eaten up by extra fuel bills, simply because your boiler tubes are coated with scale.

The "DEARBORN" TREATMENT

will eradicate this expense, as it is the best known remedy for badly scaled boilers.

It removes all scale rapidly, and when used continually prevents all new formation.

The "Dearborn" method has proved so enormously successful because each case has individual attention.

Send us a gallon of your Feed Water. We will analyze it and let you you know the exact cost of a treatment especially prepared for your plant.

DO NOT DELAY—WRITE US AT ONCE.

Dearborn Drug and Chemical Works

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The Walsh Boiler Compounds

For the Scientific Treatment of Feed-waters.
For the Cleansing of Steam Boilers.

Mr. Engineer is pleased and satisfied with his job, because his Boiler is cleaned, by using Walsh's Boiler Compounds.

Mr. Manufacturer is also delighted because he has saved tons of COAL during the year by using Walsh's Boiler Compounds.

We guarantee to prevent PITTING where returned water is used.

Ask for Booklet on the Scientific Treatment of Boiler Troubles.

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Laboratory and Factory: 67 Bay Street North. Office: Room 4, Rebecca and Hughson Streets.
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"ECLIPSE" BOILER ENAMEL

"ECLIPSE" BOILER ENAMEL IS A THOROUGH PREVENTATIVE OF THE FORMATION OF BOILER SCALE, PITTING, CORROSION, FOAMING, ETC., IN ANY WATER.

No new scale can form in any boiler in which "Eclipse" is correctly used.

Old scale is quickly removed by its action.

BOILER PROTECTION

In "Eclipse" Boiler Enamel we have a preparation which gives no heed to the class of water used. but in every case puts a filmy coating over the heating surfaces of the boiler, which makes it absolutely impossible for solid matter in any form to adhere to the iron. The scale-forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler in the form of a soft, soapy mud which will not burn or blister, and is most readily blown from the boiler.

WRITE FOR LIST OF USERS THEN WRITE THEM FOR FULL INFORMATION RE-, GARDING THE EFFICIENCY AND RELIABILITY OF THIS SERVICEABLE BOILER ENAMEL.

Write at once and LET THE USER CONVINCE YOU before you buy. His testimonial will be a great advertisement to us.

OUR PROPOSITION

The following letter, which accompanies every trial shipment of "ECLIPSE" BOILER ENAMEL, speaks for itself:

Messrs..... ..... Winnipeg. ....

Gentlemen,—We have shipped you this date .....bbl. "Eclipse" Boiler Enamel, which, when used according to directions contained in our booklet, must give you entire satisfaction in your plant, otherwise you will not be required to pay for same. We leave it to your own sense of fairness to see that "Eclipse" gets a square deal. Under these conditions we are sure of the result.

"Eclipse" Boiler Enamel is guaranteed to be absolutely harmless to the boilers or the fittings. Being harmless, it is slow in its action on old scale, but it is deadly sure. Yours very truly,

Send for our booklet to-day

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Because of their quality, Detroit Lubricators are the world's standard of excellence.

One and a quarter millions of Detroit Lubricators are giving satisfaction to-day wherever lubricators are used.

And wherever a Detroit Lubricator has been used, the name Detroit has come to mean quality.

Quality has made Detroit Lubricators the standard for over thirty-three years.

Imitators have made lubricators that look like Detroits, but they haven't imitated Detroit quality.

They might, perhaps, if they had the long experience, skilled knowledge, great organization and wonderful plant that is behind Detroit Lubricators—but they haven't.

And they haven't the spur of keeping the leadership and the pride in the product which from the beginning has made the Detroit the Lubricator of Quality.

Write to-day for Catalog A58 and full information.

DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

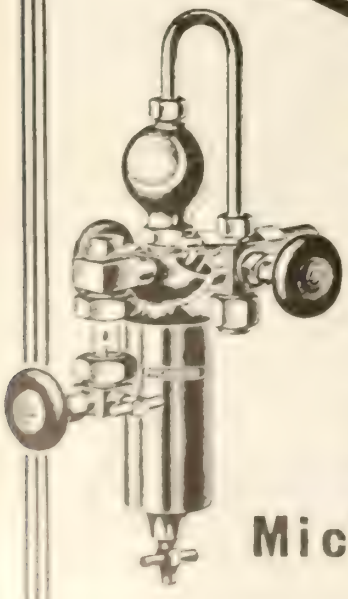
Largest manufacturers of lubricating devices in the world.

This CATALOGUE is A HELP to Engineers

A help because it gives much useful information on how to use lubricants economically and successfully.

It contains 105 pages of cuts and descriptive matter on our different models of lubricators.

Write us at once.



We are specialists in this line, having been engaged in making Lubricators, Oil Cups and Oil Pumps for over a quarter of a century.

Every article that leaves our shops we guarantee to give perfect and satisfactory service or money refunded.

Michigan Lubricator Co.

Detroit, Mich.

Don't fail to mention this paper in writing to advertisers.

Cut Down Your Lubricating Expense!

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Here is the Reason

Oil used on machinery cannot be properly controlled which results in wasted lubrication by dripping and being whirled from moving parts.

When grease is properly made and used in the "Philadelphia" Grease Cup, it is under perfect control and can be regulated to insure the least possible frictional resistance.

"PHILADELPHIA" GREASE CUP

The "Philadelphia" is the source of real economy and efficiency.

Here are a few of its advantages :

The feed force in the "Philadelphia" (compressed air") insures absolutely even pressure until the last drop is used.

The "Philadelphia" is just as positive in its action in whatever position it is placed.

The "Philadelphia" is not affected by centrifugal force when used on loose pulleys.

The "Philadelphia" saves time and labor, requires no attention, increases efficiency, decreases expense, and is absolutely dustproof.

The "Philadelphia" is made in four sizes, ½ oz., 1 oz., 3 oz. and 6 oz., both plain steel and polished.

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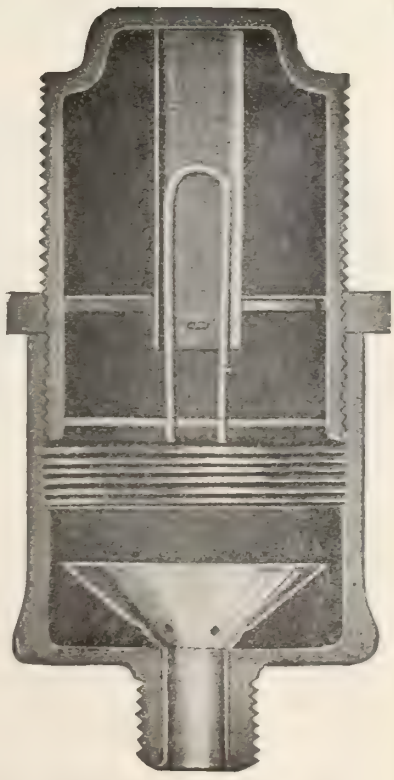

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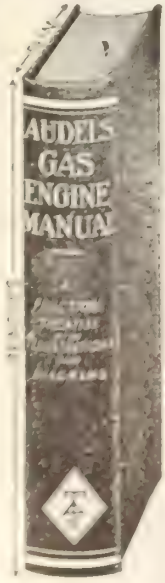

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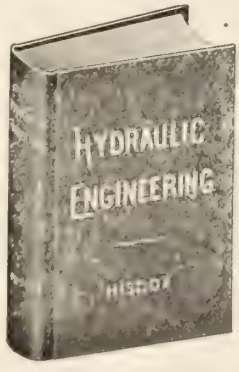

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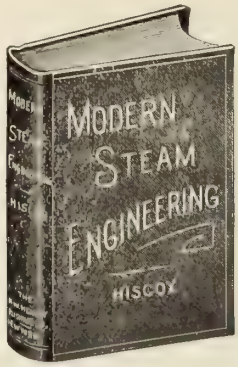

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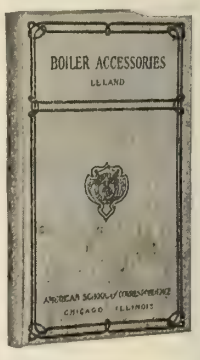

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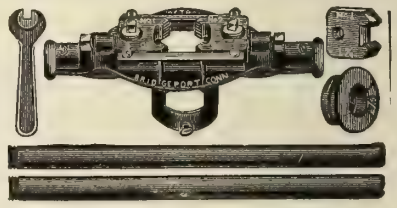

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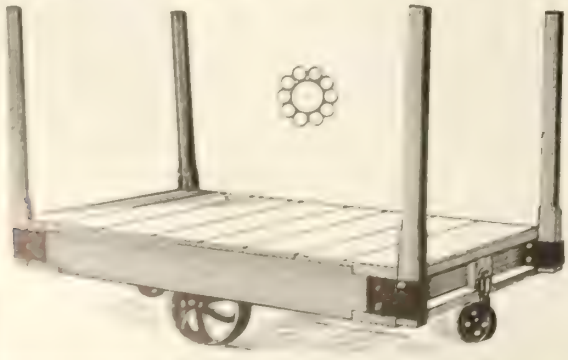

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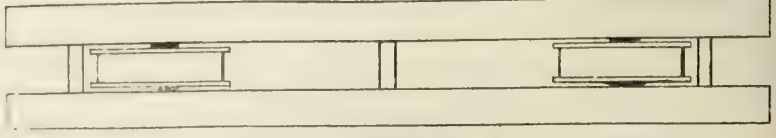

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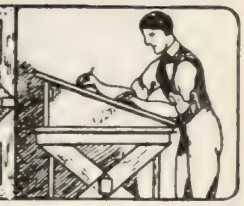

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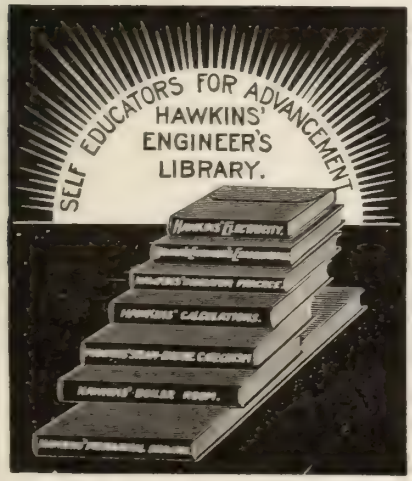

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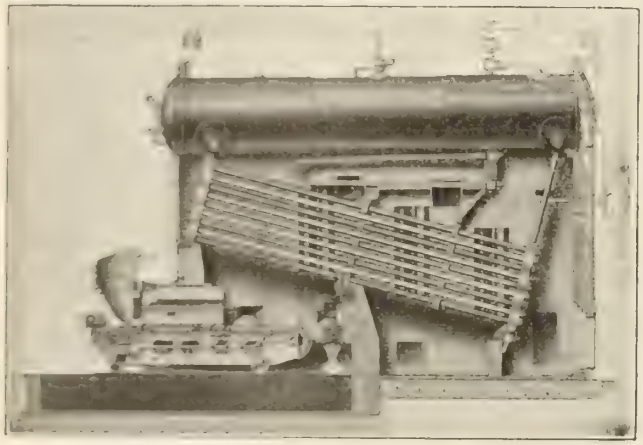

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Elmira Machinery and Transmission Co., Elmira
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Crank and Crosshead Pin Oilers.

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Canadian Fairbanks Co., Ltd., Montreal

Dynamos.

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Standard Eng. Co., Toronto

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Darling Bros., Montreal
Standard Engineering Co., Toronto.
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General Supply Co. of Canada, Ottawa
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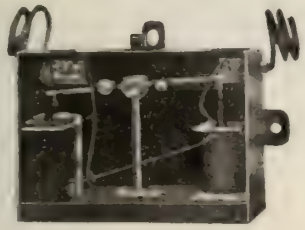

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Waterous Engine Works Co., Brantford.

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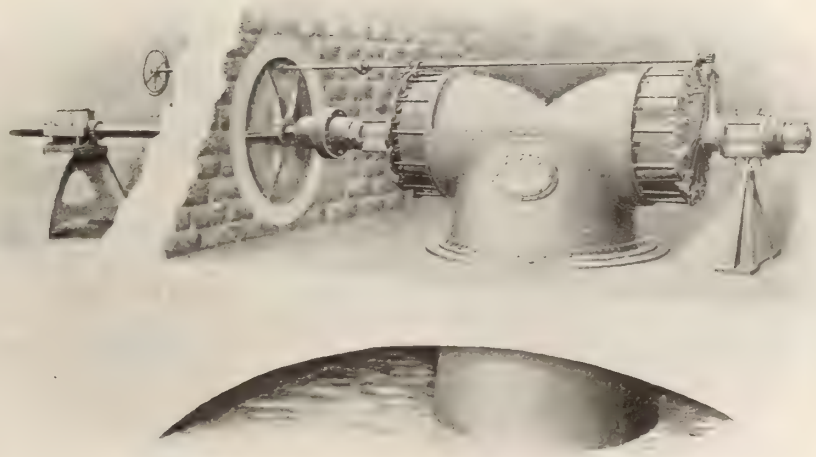

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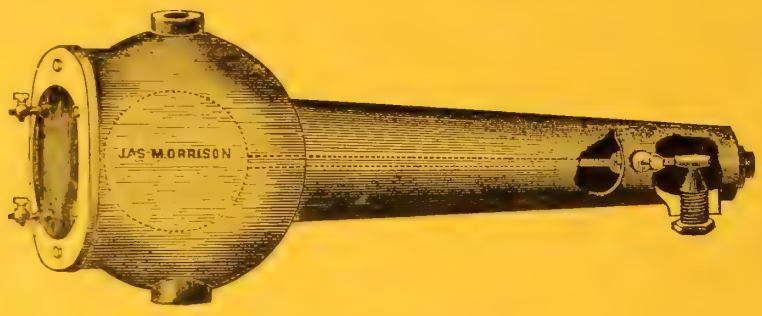

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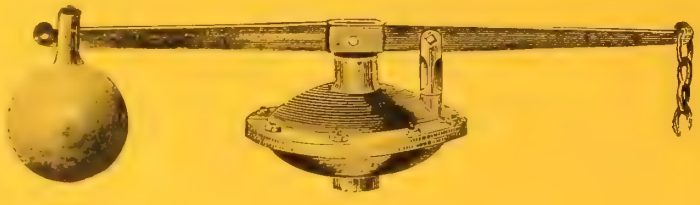

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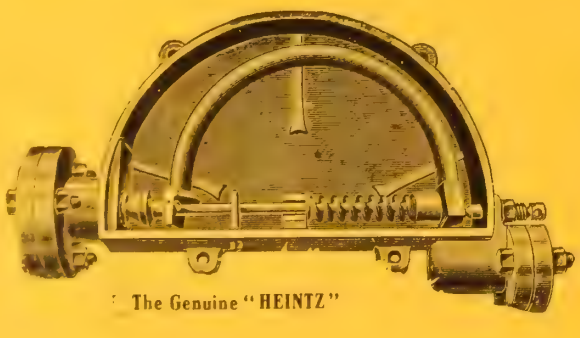

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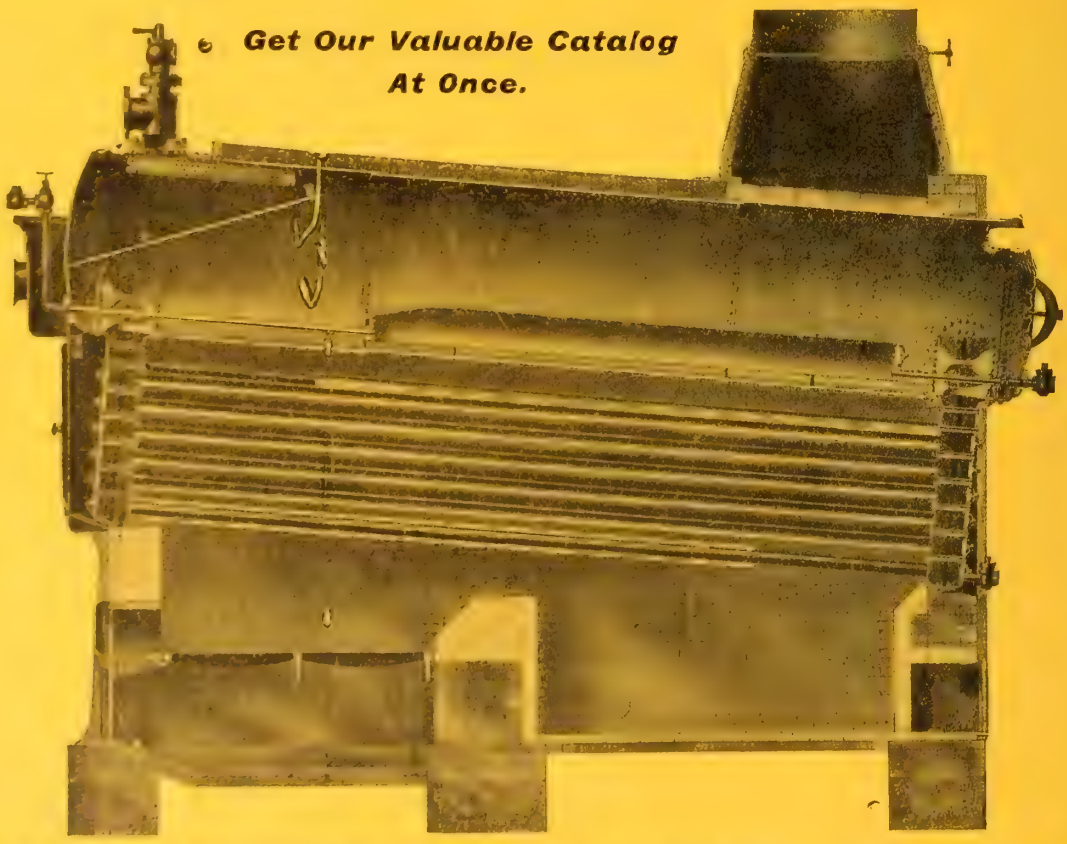

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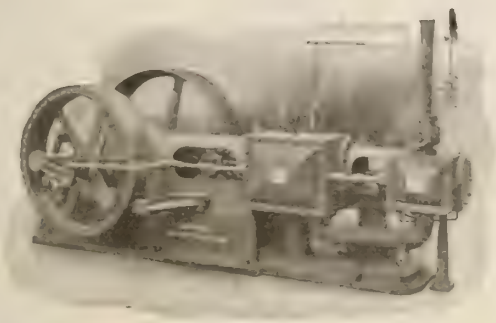

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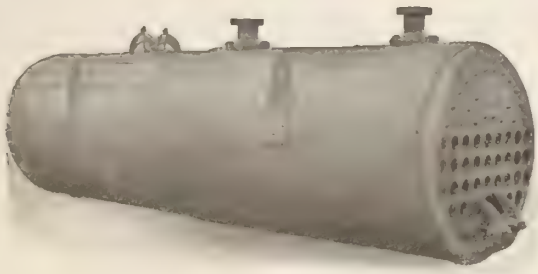

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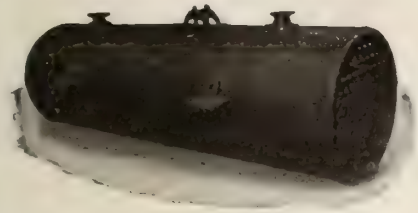

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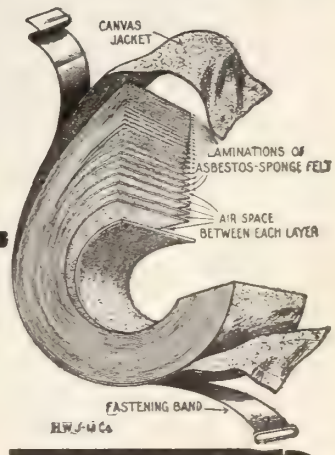

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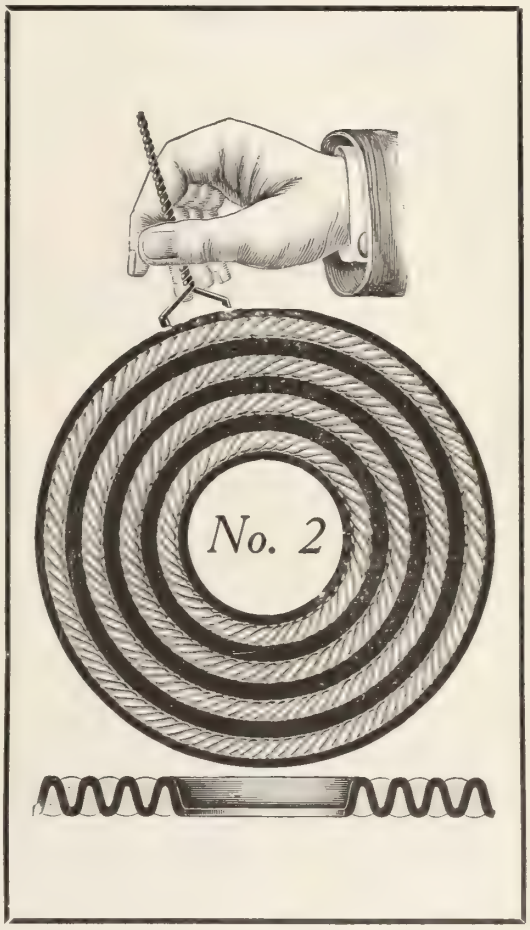

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Goodyear Air Hose is further protected from cuts and bruises by a heavy canvas jacket. This brings an extra thick ply of rubber between outer canvas cover and first inner layer of fabric, resulting in a hose o unequalled strength and toughness.

Can be supplied with the further protection of wire winding or Marlin wind. Made in three grades. Used in practically all mining operations, steel construction works and boiler works—wherever pneumatic tools are in use.

Write to-night for catalog and prices.

The Goodyear Tire & Rubber Company of Canada, Ltd.

General Offices—Toronto Factory—Bowmanville, Ont.

Write Our Nearest Branch

BRANCHES: Montreal—Winnipeg—St. John, N.B.—Vancouver—Calgary

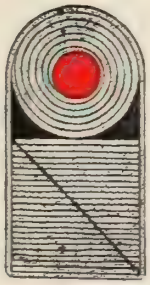
Victoria, B.C., 855 Fort Street; Regina, Saskatchewan, 2317-2318 South Railway Street; Hamilton, Ont., 127 King Street West

DUNLOP

PISTON ROD PACKING

works equally as well on a heavy pump as on the most sensitive valve stems. No matter for what purpose used—steam, water, ammonia—it proves to be highly effective. Oils, alkalies, etc., do not affect the life of the packing in any way.

The pressure of Dunlop Piston Rod Packing on the rod is never greater than necessary, therefore friction is reduced to the minimum. It is self-lubricating and cannot become hard under any condition. This is a big point in its favor when you consider that hardened packing will not give, thus causing great pressure on the rod; with the result: greatly increased friction and loss of power. The lubricants used in the preparation of Dunlop Piston Rod Packing are the best and most approved of. They enamel the rod (filling in the scores, if any) and assist it to work easily and freely. The packing is self-adjustable and is not affected by the vibration of the rod.



Dunlop P.R.P. before pressure from the Gland is applied in the Stuffing Box.

When in the market for Packing, Belting, Hose, Valves, etc., consult us. We have everything that will meet your requirements and give the greatest satisfaction. We make a suitable article for every specific purpose. If you purchase our line you will be one of the many who realize that fact.

Link yourself up with our "Two Hands" trademark—it's your protection and satisfaction.

Dunlop P. R. P. under pressure showing how it expands to take up wear from the rod.

Write us at once for full particulars

DUNLOP TIRE & RUBBER GOODS
COMPANY, LIMITED

Head Office and Works: TORONTO

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TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

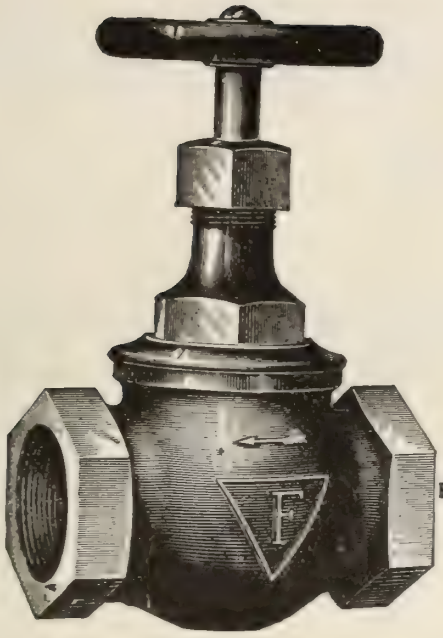
If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL



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"The World's Standard"

Will appeal to the discerning buyer. They are widely known and popular among all engineers—and deservedly so. In design they are simple—in construction and composition only the finest workmanship and best-grade bronze have been used. They are heavily built and well proportioned, being fully capable of standing rough treatment and any pressure up to that specified for each valve.

WE SHALL APPRECIATE YOUR
FURTHER ENQUIRIES

THE CANADIAN FAIRBANKS-MORSE CO.
LIMITED

Fairbanks Standard Scales—Fairbanks-Morse Gas and Gasoline Engines—Safes and Vaults

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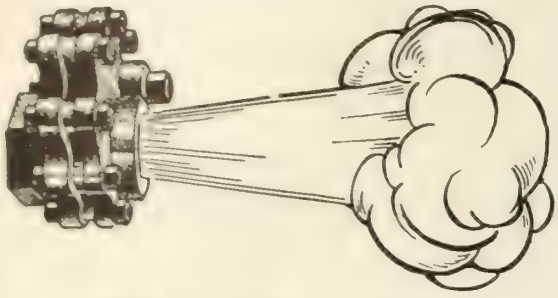
The Season's Greetings to You



"IT NEVER LEAKS."

EVERLASTING BLOW-OFF VALVE

Engineering Specialties Company

1080 King Street West
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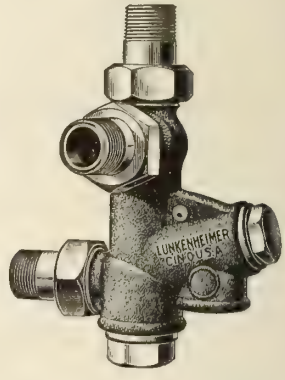
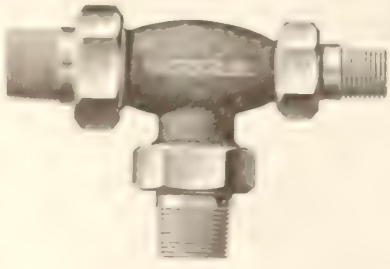
LUNKENHEIMER
Automatic Injectors and Ejectors



Excel those of any other known make. They will deliver more water per pound of steam than any other, which means a saving in fuel, and the maximum capacity can be graded over 50 per cent.

LUNKENHEIMER AUTOMATIC INJECTORS

will lift water quite a height, take very hot water and will force against a much greater pressure than that of the boiler. They are made in five types to facilitate connecting.



Your local dealer should have them, if not, write us.

THE LUNKENHEIMER COMPANY

LARGEST MANUFACTURERS OF HIGH-GRADE ENGINEERING SPECIALTIES IN THE WORLD

GENERAL OFFICES AND WORKS:

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WE take this opportunity of extending to our Engineer friends our heartiest wish that they may enjoy a Merry Christmas and all prosperity in the New Year.

DART UNION CO., LIMITED
TORONTO

The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
141 King Street East,

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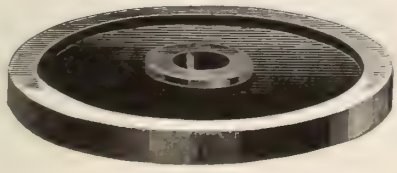
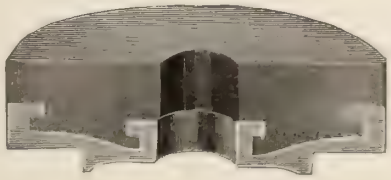
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES





Give better service than any other, and last longer.

Brass Casing prevents ports from forcing through.

Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.

THE "IDEAL" PACKLESS VALVE

Should Interest You, Mr. Engineer.

It is a valve that needs no attention, after once installed, in the way of packings.

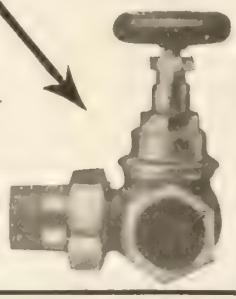
Does away with expenses in keeping up an ordinary valve and prevents accidents that are liable to occur by escaping steam, water, or gas.

It is guaranteed not to leak under any pressure up to 200 pounds.

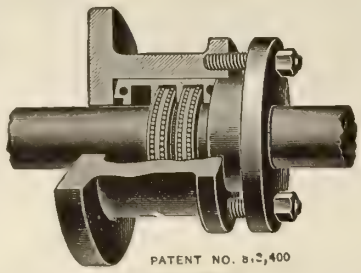
The "Ideal" Packless Valve is neat in design and construction and is made to meet the requirements of every boiler room.

We invite comparison between any of our products and those of other manufacturers whether in material or workmanship.

You will save much trouble by writing us.



The Ideal Packless Valve Co., Ltd.
WALKERVILLE, ONT.



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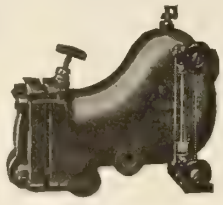
Why not Buy the Best, when in market for Packing?

HOLMES'
Metallic Packing
is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.



McDANIEL IMPROVED STEEL TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

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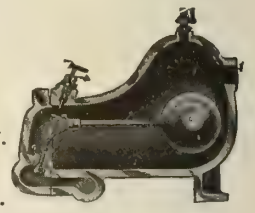

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26 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, ONT.

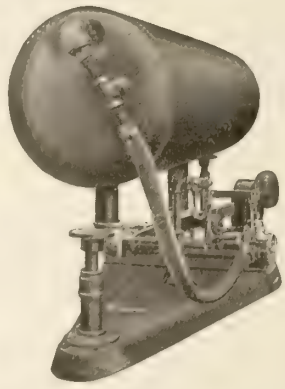
Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO



The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

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Canadian Representatives—Geo. W. Cole, c/o A. R. Williams Machinery Co., Toronto, Ont.; W. H. Markle, Montreal; Park Bros., Chatham, Ont.; W. H. Rosevear & Son, Winnipeg, Man.

The SKINNER Valve Re-seating Tool

A Time, Money and Valve Saver which should be in YOUR plant.

Prices f.o.b. Montreal
½" to 2" - $20.00
½" to 3" - $30.00
Neatly packed in wooden box.

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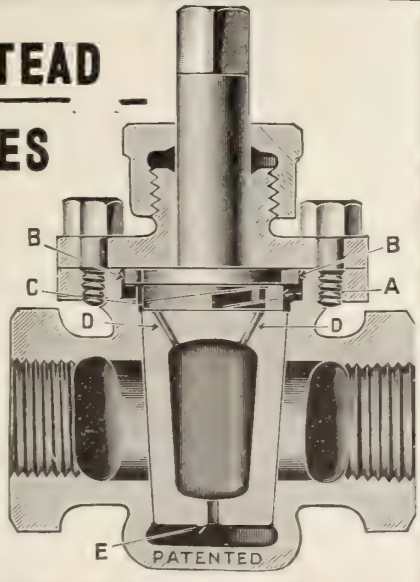
HOMESTEAD VALVES

Have no Equal for Simplicity and Durability



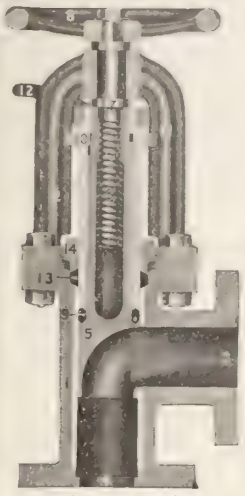
They are unexcelled for any service involving the handling of high pressures in steam, gas, water or hydraulic work. The seats are absolutely protected against wear. The plug is balanced and held in place by pressure when open, and when closed it is locked in the seat by our patent wedging cam. That's what makes Homestead Valves outwear all others.

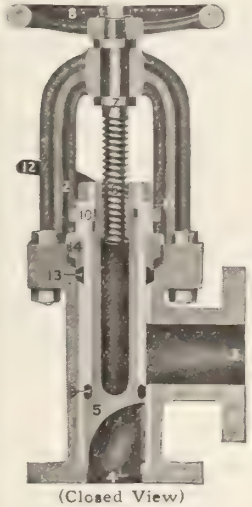
A quarter turn opens or closes the valve—no waste of time or energy.

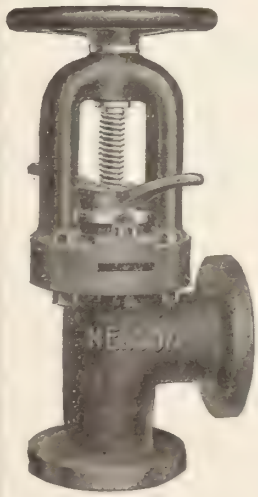
A catalogue describing Homestead Valves is yours if you tell us where to send it.

Homestead Valve Mfg. Co.
Works: HOMESTEAD, PA.
P.O. Box 1754, Pittsburg

We Forgot


(Open View)


(Closed View)



to tell you one thing about the

NELSON
TRADE-MARK REGISTERED

Blow-off Valve

that you wanted to know. That is that both packings are *protected* from the fury of the blow-off action, both in open and closed position.

The cuts tell the story.

When **open**, the lower packing is above the port and the violence of the pressure attacks only the curved end of plunger (5) which it cannot harm. Both packings are adjusted independently of each other, from outside the valve where you can easily get at them. The outside view shows the lever wrench, to adjust the lower packing. The upper packing ring is adjusted by the bolted gland.

When **closed**, the pressure is exerted against the bronze sleeve, with both packings entirely out of the way, yet so situated and controlled as to keep the valve tight.

The simplest and most efficient blow-off valve. No **seats** to score. No **discs or plugs** to wear out. No **pockets** for scale to collect. **Easiest flow** possible. Nothing in its construction that can in any way cause trouble.

GUARANTEE—We guarantee the **NELSON** Blow-off Valve. It is patented. Its name is trade-marked. We couldn't afford to put our name on it if it was not right. If, after 60 days of use, you are not satisfied, send back the valve and we will refund the price you paid for it. Could we make you a better or more reasonable offer that that?

Sizes 1½ in., 2 in., 2½ in., and 3 in. Iron Body, for 300 pounds working pressure; Steel for extreme service. Also made in Straightway Type, same sizes, iron or steel.

Mail coupon for catalogue and prices.

Nelson Valve Company 12-14 University St., **Montreal**

Please send me catalogue and prices of NELSON Blow-off Valves.

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EFFICIENCY AND ECONOMY IN THE BOILER ROOM

We guarantee that we will give you more steam with less fuel than you can possibly get with old-fashioned fixed grates.

We supply our grates for all kinds of boilers, brick kilns, gas producers and other furnaces.

Write for further particulars. Estimates free.

20th Century Shaking and Dumping Grate Bar.

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Head Office:---69 Adelaide St. East, Toronto Phone---Main 1608

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless

Sold on APPROVAL

We Will Loan You a
Vulcan Soot Cleaner
For Thirty Days' Trial

The heating surface of your boilers is, in a way, the foundation of your whole plant. Every square foot of this heating surface has cost you money, and this surface is limited. If half or more of this surface is coated with soot you cannot get the greatest HEAT ABSORPTION, nor can you get the full-rated boiler efficiency. Consider the SOOT PROBLEM. It is simply a case of Soot vs. Efficiency—which will you have ?

The big railway companies are buying from $5,000 to $20,000 worth of our Cleaners every year. Why ? Because they get their money back in coal saved in from three to six months.

ASK US ABOUT IT TO-DAY.

VULCAN
TUBE CLEANING SYSTEMS LIMITED

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THE
CANADIAN CASUALTY
AND
BOILER INSURANCE COMPANY'S

NEW BLANKET POLICY IS THE MOST LIBERAL INSURANCE CONTRACT NOW ON THE MARKET

IT COVERS ALL LOSSES TO LIFE AND PROPERTY

INCLUDES HIGH CLASS INSPECTIONS AND ENGINEERING ADVICE

CONTINENTAL LIFE BUILDING
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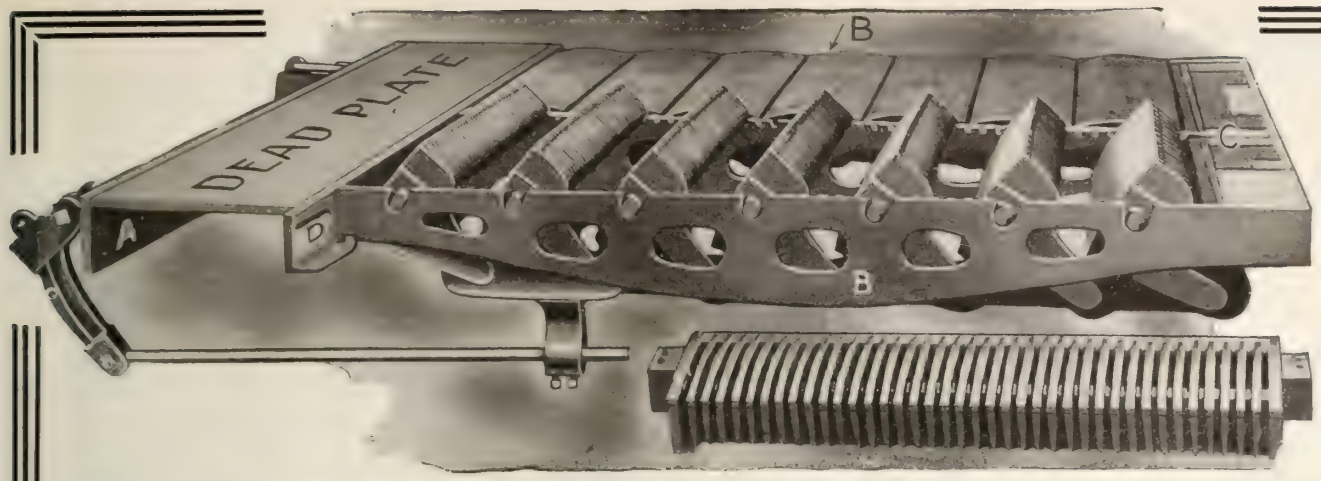

The Cyclone Shaking and Dumping Grate Bar

is a product of careful study and experienced workmanship. Its many late improvements make it the most efficient and most economical grate bar on the market.

The new centre rib strengthens the centre of the bar, and prevents the webs from warping out of place.

Notice the improved shaking motion, whereby you can shake the ashes off the centre bar without letting the coal go through.

Write for full particulars and prices.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

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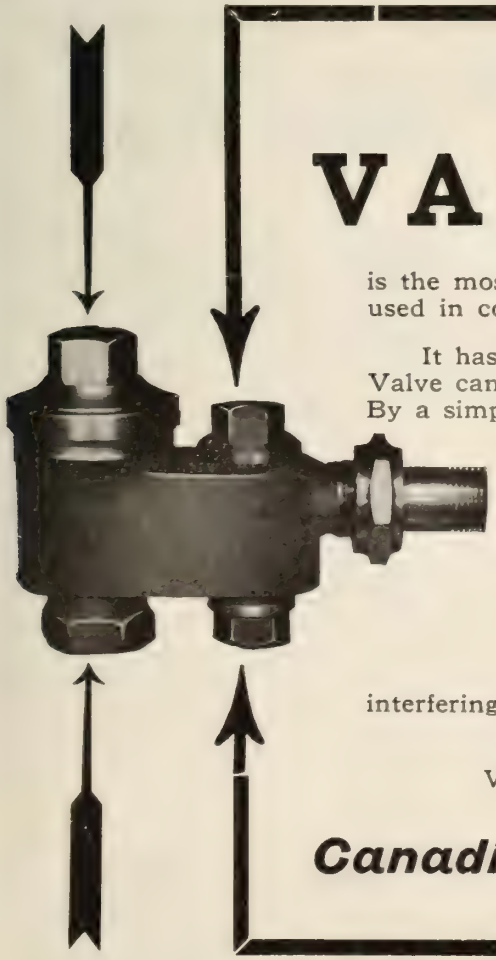

THE "ECONOMIC"
VACUUM VALVE

is the most economical, most important and most efficient device used in connection with Vacuum Steam Heating.

It has been tested under all conditions for which a Vacuum Valve can be used, and found to be MECHANICALLY PERFECT. By a simple device we have made it impossible to flood or stop this valve from working.

Will permit higher temperatures and increased efficiency of Dryers, Dry Kilns, Blast Heaters, Coil Stacks, Paper Cylinders, etc., by removing water of condensation automatically by means of a float.

This valve is so simple and so well constructed that it cannot cause the engineer a particle of trouble. Condensation chambers can be easily cleaned without interfering with the circulation.

WRITE US AT ONCE FOR FULL PARTICULARS

Canadian Steam Boiler Equipment Co.
Limited

186 Queen Street East, Toronto

Don't fail to mention this paper in writing to advertisers.

NO LOSSES

THERE are no grate bars in a Jones stoker, consequently NO LOSS of fuel through the bars.

The gases are driven off the coals and mixed with air ***beneath*** the fuel bed, pass through the fire, are brought up to the ignition temperature and consumed, consequently NO LOSS in unburned gases! NO SMOKE!

Utilizing the fuel with a minimum of loss, and with the automatic regulation of the steam pressure by the steam pressure itself, make a Jones Underfeed Stoker installation an ideal system of firing a steam boiler plant.

Let us tell you more about it.

Jones Underfeed Stoker Co., Limited

National Trust Building
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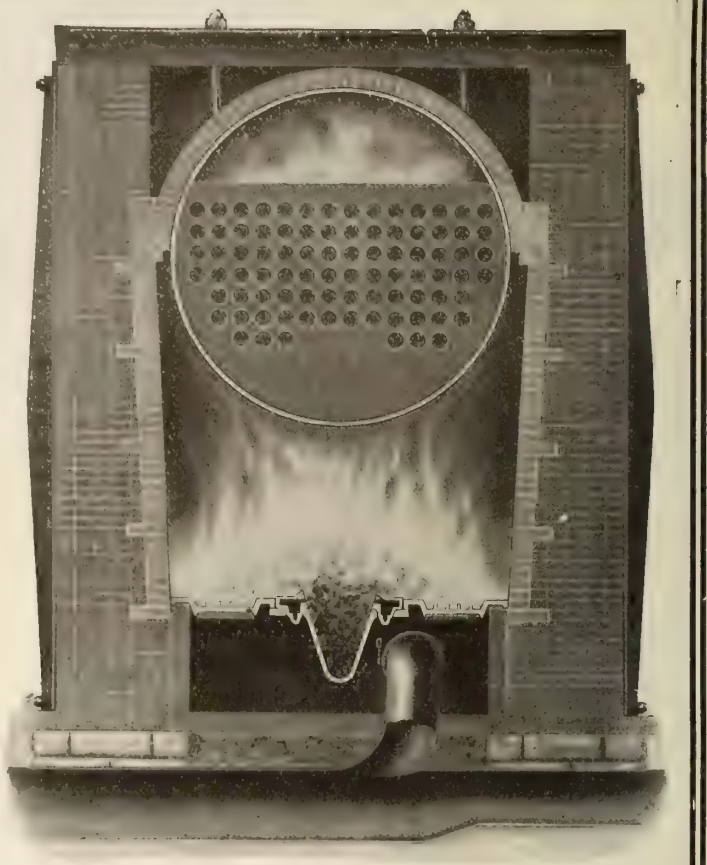
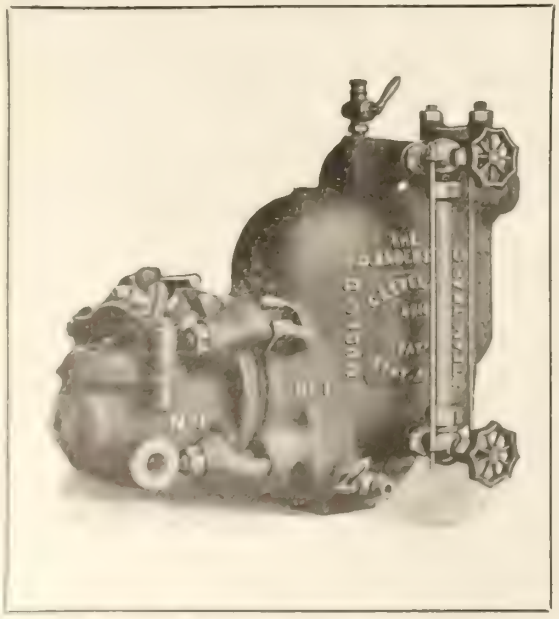


The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

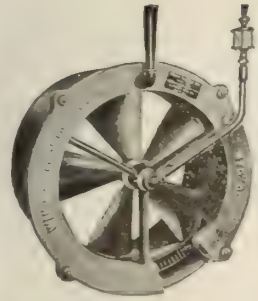
We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

Let The "Typhoon" Turbine Blower Save YOU Money!

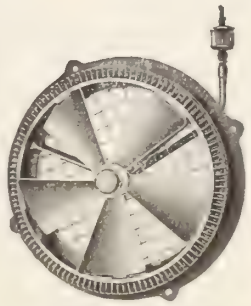


Exterior View
Blower Complete

Its use means **Increased Boiler Efficiency**; the most **Economical Consumption of Fuel**; a grate that is always free from clinkers.

The "TYPHOON" Turbine Blower produces a powerful forced draft, which mixes thoroughly with the small quantity of dry steam used in driving the machine, passes under the grate and gives the most powerful combustion ever obtained by any mechanical or natural draft system.

Means Economy in Fuel because the cheapest grades can be used and still produce the required amount of steam.



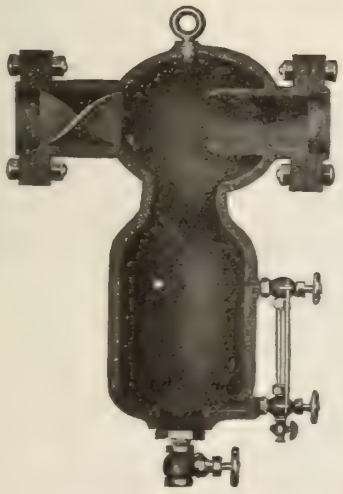
Interior View
Casing Removed

This little device is inexpensive---write at once for particulars and prices. We are receiving many repeat orders from some of the largest firms in Canada.

Keep Water From Entering Cylinders

By installing the

"Swartwout" Steam Separator



Horizontal Steam
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On all of the **"Swartwout"** apparatus, as manufactured by us, the helico-centrifugal principle is applied. Not only does it positively compel separation, but the desired result is secured without imposing an ounce of resistance.

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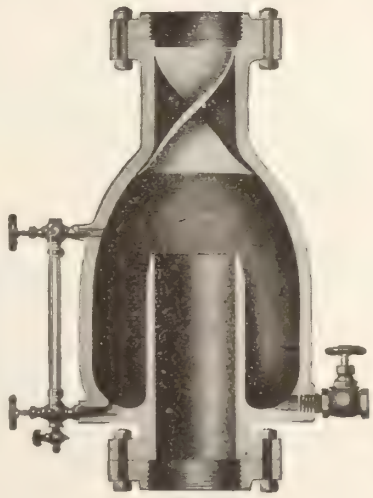

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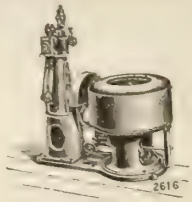
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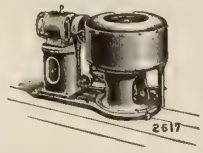
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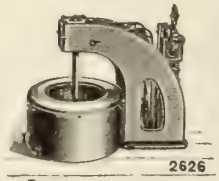
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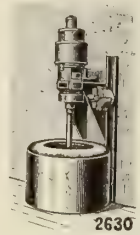
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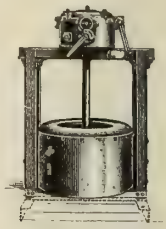
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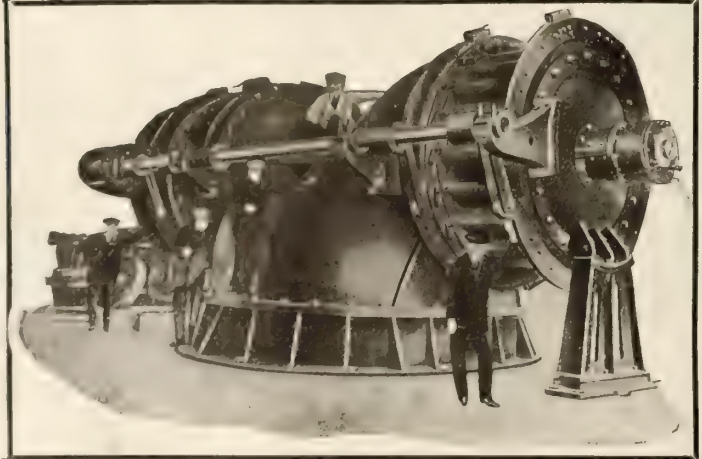

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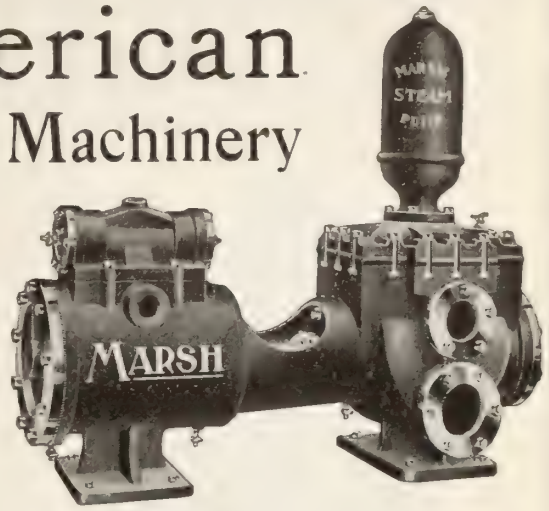

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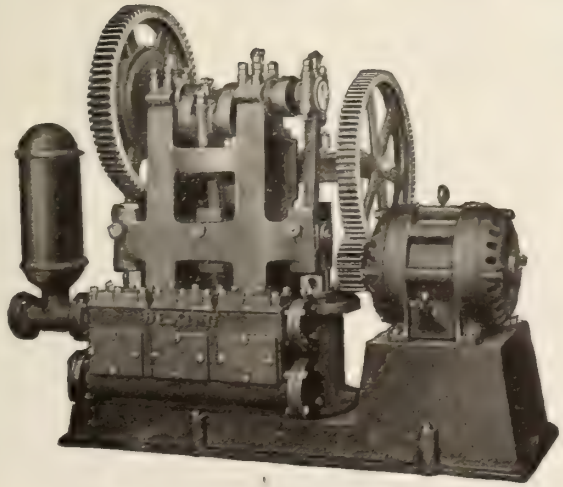

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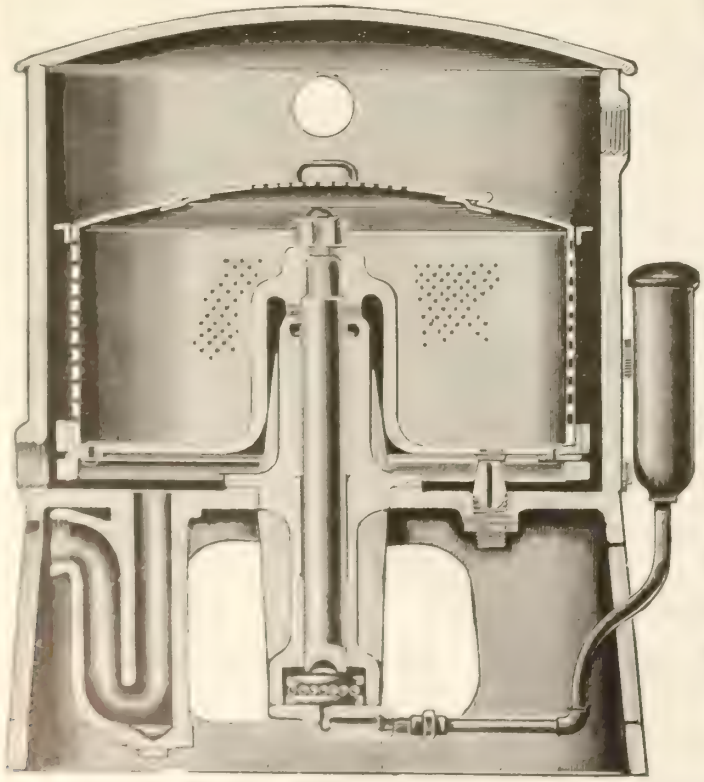

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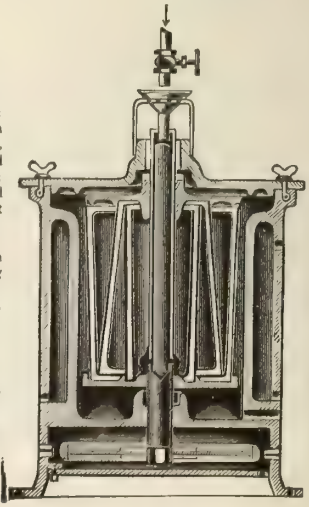

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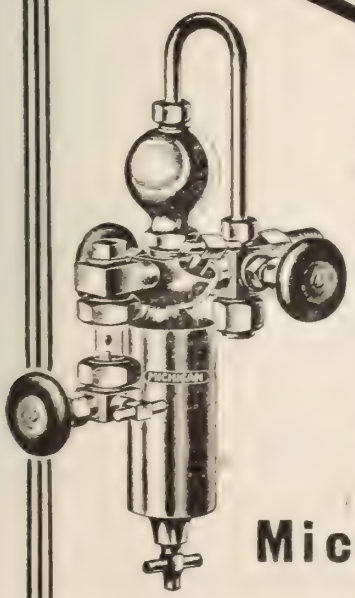

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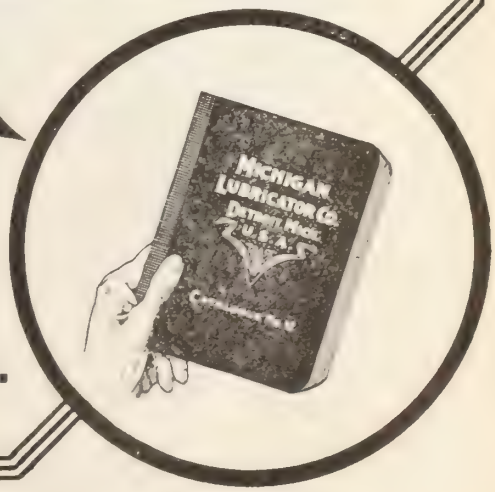

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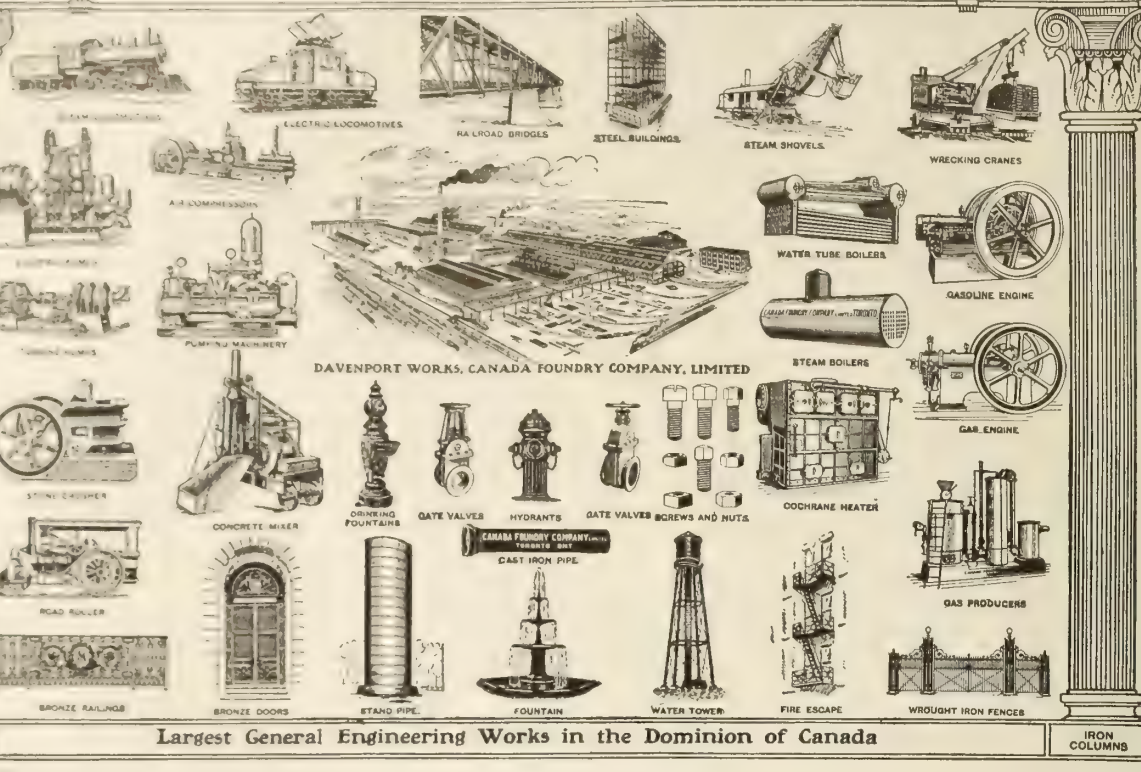

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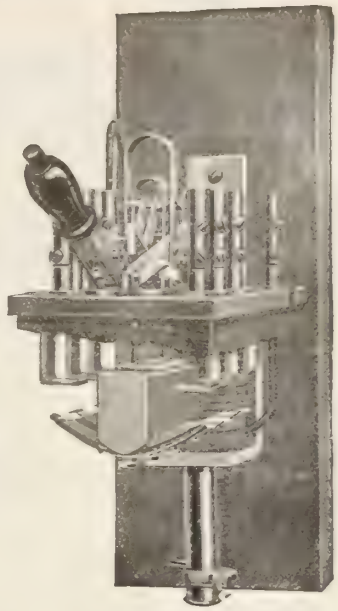

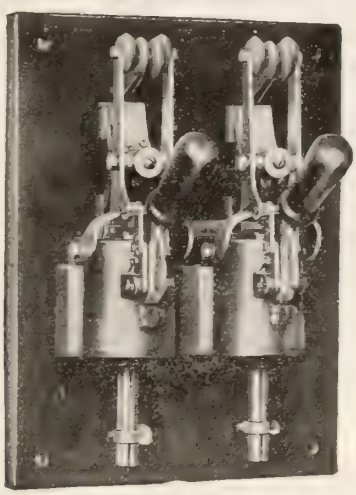

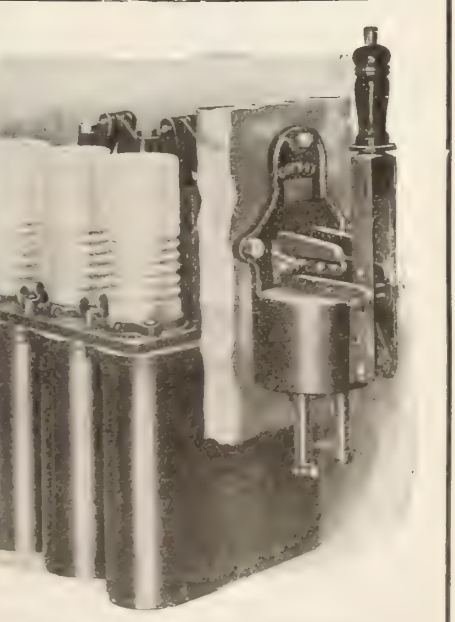

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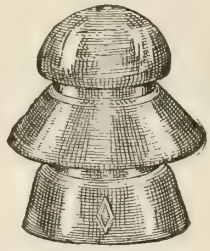

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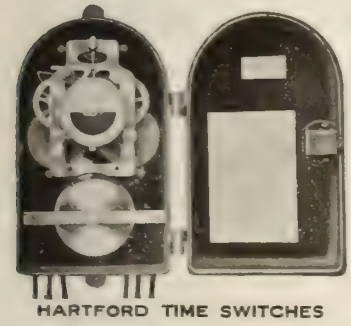

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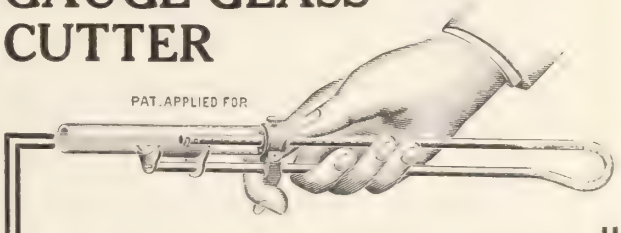

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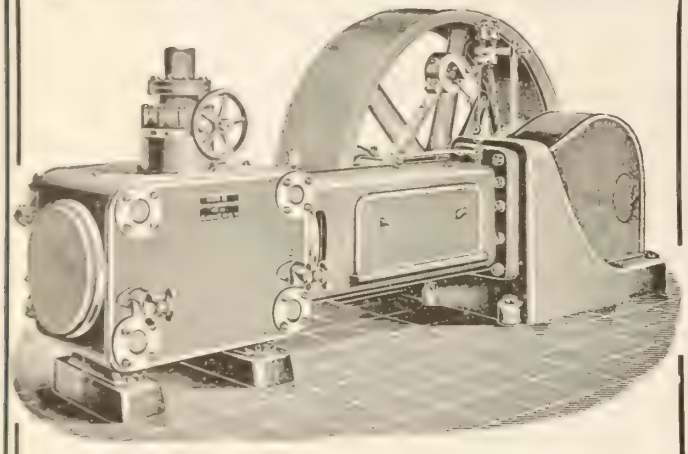

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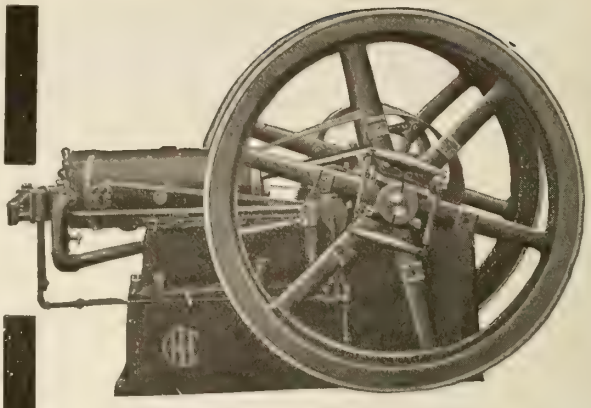

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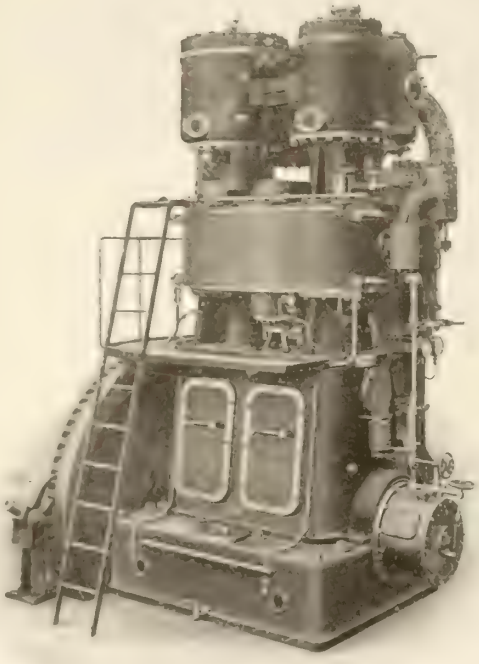

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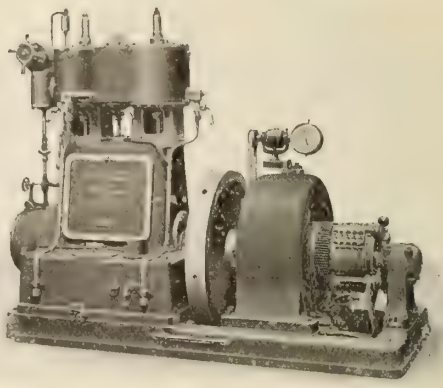

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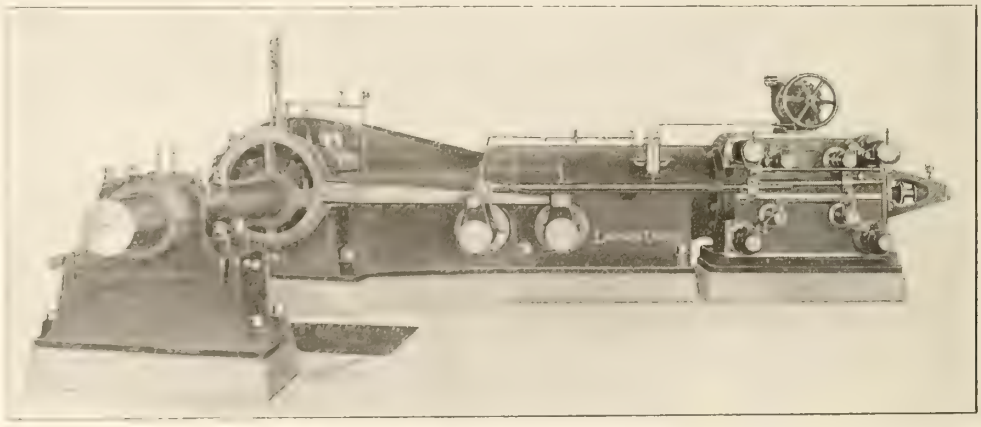

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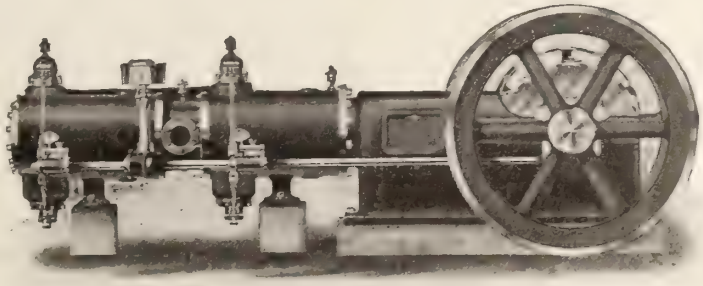

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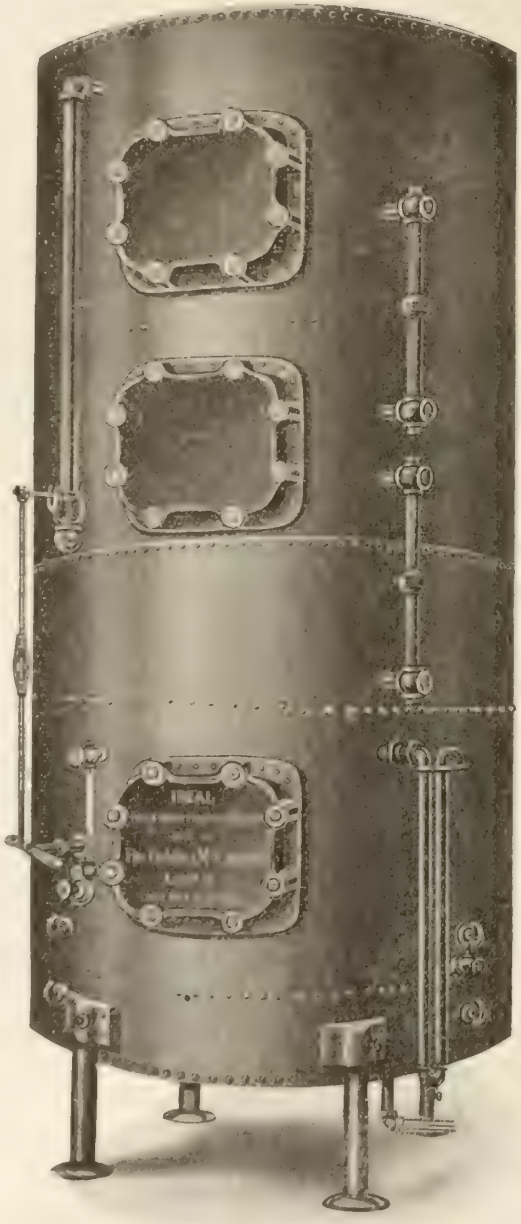

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Water Turbine Hydro-Electric Plant, Wangen, Switzerland

By C. T. R.

In view of the widespread interest being taken in the development of Canadian water powers, it will be of interest to our readers to know what the outside world is accomplishing in a like direction, and to become conversant with the methods and equipment adopted to surmount difficulties and secure efficiency of operation. The plant here described is worthy of careful and close scrutiny.

THE WANGEN POWER PLANT.

AT Wangen on the Aare in Canton Berne, the Elektrizitats-Aktien-Gesellschaft, late Lahmeyer & Co., of Frankfort-on-Maine, have built water power works which form one of the more important of the large hydro-electric central stations in Switzerland. The water required for the works is taken from the River Aare above the small town of Wangen. A weir, 120 metres broad, has been built straight across the river, and the water flows along a canal about 8 kms. long to the turbine chambers, and from there down a tail-race 84 metres long back into the River Aare.

Extensive records and measurements, taken on the river Aare at this place, show the minimum low-water flow to be 80 cub. metres per sec., the average flow during summer months 200 cub. metres per sec., and the maximum flow in flood, 1,600 cub. metres per sec. An average volume af 100 cub. metres per sec., which could be increased to 120 or 130 cub. metres per sec. at times of least head, was assumed as a basis for the works. The static head, from the water level at the entrance of the canal to the tail-race level, where the latter discharges into the river, is approximately 10.5 metres.

It is seen at once from the above fundamental data that extensive and interesting river construction works were necessary. The 8 kms. length of canal, of a section to carry 120 cub. metres per sec. was of itself a large undertaking, and is probably the largest of its kind in Switzerland. A detailed description of these construction works is beyond the scope of this article and only the principal points of interest can be briefly mentioned.

Fig. 1.—View of the weir across the river Aare near Wangen, with the in-take sluices.

The Weir.

The concession granted by the governments of the Cantons of Berne and Soleure specified that the water-level over

Fig. 3.—View of the power house from the forebay.

the weir should not be raised more than 1.5 metres at low water and 0.5 metres during flood. A movable weir was therefore necessary, and the panel type was chosen as the most suitable. The weir is divided by masonry piers 2.5 metres in thickness into four sections; the two middle sections, each having a width of 37.24 metres, form the main spillway, and are built of solid concrete with a coping of granite masonry having a total height of 1.65 metres on the crest. Above this, eight movable panels have been erected in both sections, each of a breadth of 4.6 metres and 2.15 metres in height, built of 10 mm. iron plate, fish-shaped with double walls, and running in fixed guides of 300 mm. channel girders. The panels are raised by powerful lifting gear provided on the iron bridge, which rests on the three piers and provides communication between the two banks of the river. On the right of these overflow openings, is a log-shoot 15 metres wide, which is closed by a single panel 1.20 metres deep, fixed on the solid crest of the weir, whose height at this point is 2.60 metres above the bottom of the canal in-take.

The remaining portion of the weir next the canal in-take, on the opposite side of the river, is arranged as a flushing channel 23.6 metres broad, with its bottom on a level with the river bed. This is closed by seven pairs of similar panels, so arranged in pairs with one panel above the other, fig. 5, as to avoid the excessive thrust while raising, which would have resulted had each division been made in one piece. Each panel has its own separate hoisting apparatus. The panels themselves are also made of iron plate, so built that they can be pulled up over one another. The total height is the same as the rest of the weir (masonry + panels) 3.80 metres. The whole construction is laid on a pile foundation 30 metres in breadth, which is covered with concrete masonry and granite pitching. A general view of the complete weir and in-take sluices is given in fig. 1, while figs. 2 and 4 show the weir in plan and section respectively.

Canal Intake and Canal.

The canal in-take branches off immediately above the weir, almost at right angles to the left bank of the river. It has a clear width of 30 metres and is divided into six partitions, each of which can be closed by panel sluices. The bottom of the in-take, see fig. 1, is about 1 metre above the river bed, and is therefore nearly 2.80 metres below the average and 4.50 metres below the highest water level.

Each of the six sluice gates consists of three panels, one above the other; the two lower are movable, and are similar to those used for the flushing channel, but the upper panel is fixed. The lowest panel is approximately 1.20 metres deep, the middle one 2.0 metres, and the upper 1.8 metres; all three are of sheet iron with stiffeners of I girders on one side. The guide posts and the foot-bridge which they carry are all strongly built in iron. This arrangement allows the lowest panel to be closed during flood, and thus keeps out stones and other heavy bodies, while the upper fixed panel arrests most of the floating material which may be brought down by the river and would otherwise find its way into the canal.

Immediately behind the inlet sluices, a scour channel, 25 metres wide and with its bottom deepened down to the level of the bed of the flushing channel, curves sharply round to the right, and leads back into the river below the weir. This channel catches all gravel that may find its way past the in-take sluice gates, and discharges same into the river when the scour gates are opened. These scour gates at the end of the scour channel are five in number, and act, when closed, as an overflow, in the same way as the main weir. The canal sluice gates proper are situated about 70 metres past the in-take sluices at the same level as the latter, and are of similar construction and dimensions. After these, the canal itself begins. The fall of the canal bottom is 0.17o-oo and of the surface of the water on the average 0.125 o-oo. The flat bottom is 17 metres wide, with banks having a slope of 1 to 2. The depth of water in the middle of the canal is normally 4 metres, but rises to 4.4 metres in time of flood. A maximum velocity of 1 metre per sec. produces a discharge of 120 cub. metres per sec. Parts of the canal, depending on the condition of the ground have both banks and the bottom lined with concrete slabs. Several 'structures' presenting considerable difficulty had to be carried out at different points on this long canal. For example, the railway is taken across the canal on two high piers; the "Moosbach" stream had to be diverted underneath through a syphon; and several highway bridges of which one has 45 metres span. were built over the canal. The canal passes close to the river bank at a point about 1 km. from the power house and the retaining wall necessary here on the side of the river is used as an overflow for excess water. Shortly before reaching the power house, the canal widens out to form the forebay, which is 25 metres long and extends over the whole width of the turbine chambers, being thus 54 metres broad. The bottom of the forebay lies 1 metre higher than that of the canal. The net fall obtained at the turbines by means of this canal is approximately 9.27 meters during minimum flow of the river, but dimin-

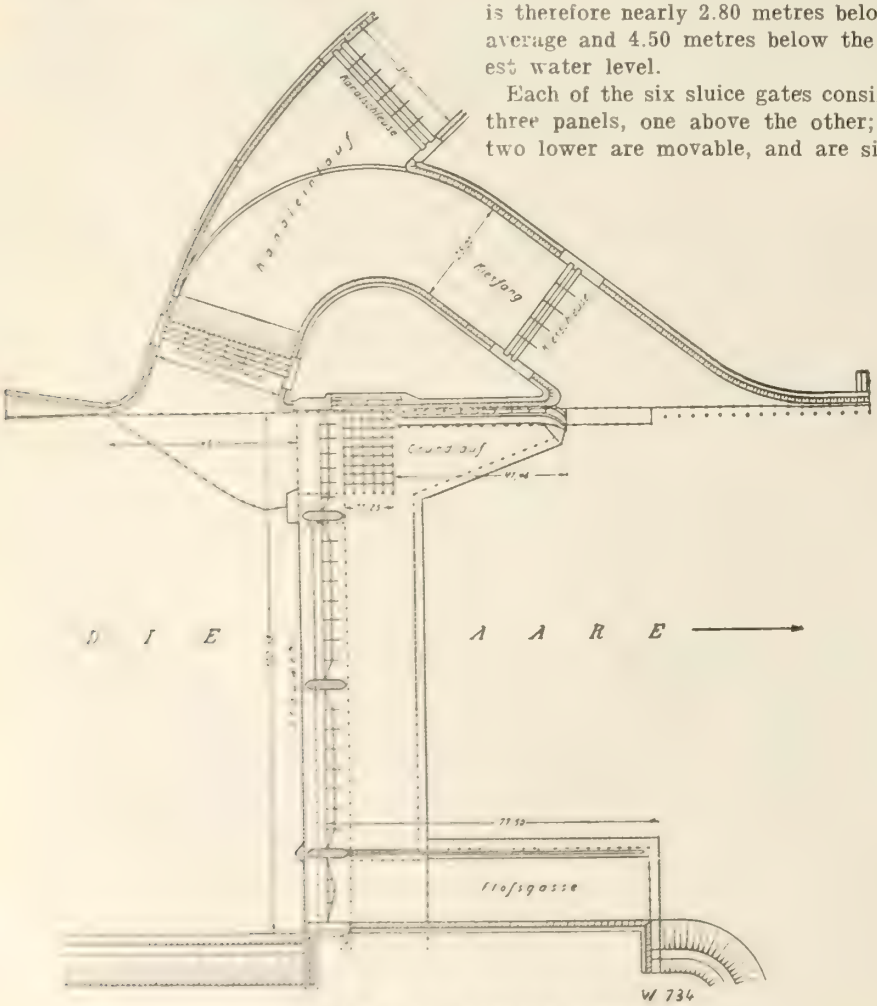


Fig. 2. Weir and canal in-take.

ishes to 7.7 metres in flood time. The total effective power on the turbine shafts is 7420 h.p. for minimum, and

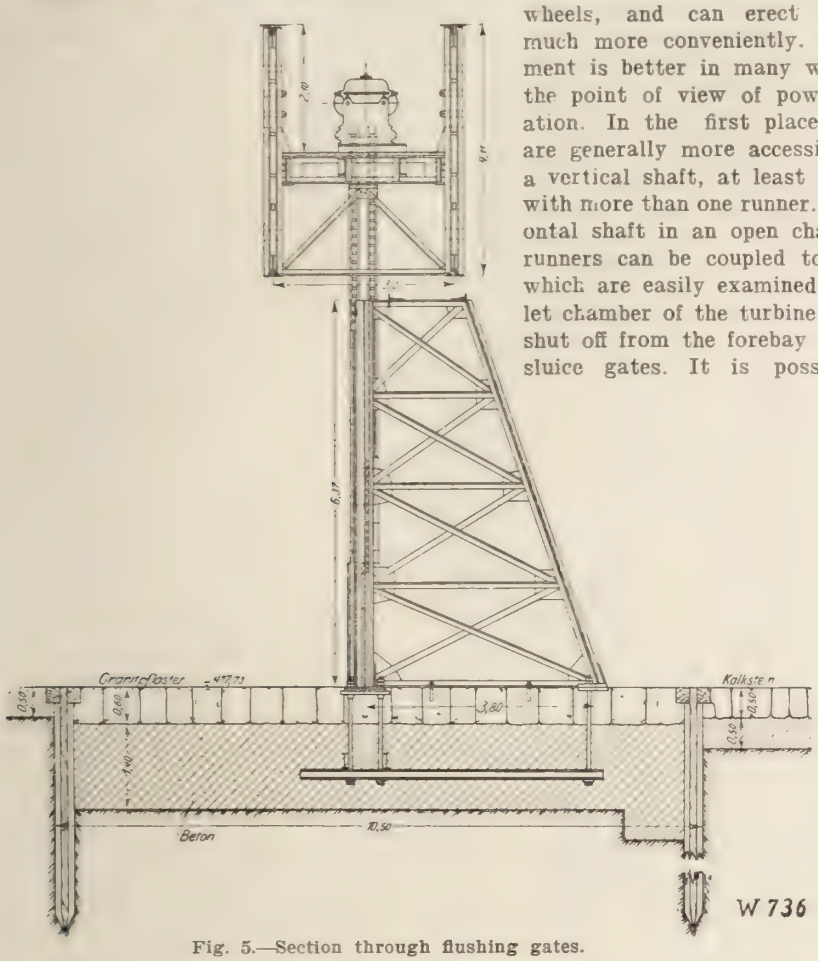


Fig. 5.—Section through flushing gates.

9240 h.p. for average and maximum flow of the river.

The state of the ground, where the canal (as mentioned above) lies very near the river bed, caused great difficulty with the foundations, since the canal water level is 8 metres above the river. Solid rock is only found at great depth, and the engineers considered that it was not necessary to carry the foundations to this. Unfortunately, however, cracks began to form shortly after the works were started up, and it was found necessary to rebuild the foundations over a considerable distance along the river bank, part of the work requiring pneumatic caissons.

Question of Choice of Turbines.

Although common practice in large Swiss water power stations with small fall and large quantities of water had previously been, almost without exception, to provide single or multiple turbines with vertical shafts, it was decided to use turbines with horizontal shafts for this station.

Where the conditions of fall are such as allow the electrical generator to be placed above the maximum tail-race level, there is considerable advantage in the arrangement with the horizontal shaft. It is also preferred by the electrical manufacturers, because they can then use their usual type of magnet wheels, and can erect the generator much more conveniently. This arrangement is better in many ways, including the point of view of power-house operation. In the first place, the turbines are generally more accessible than with a vertical shaft, at least in those types with more than one runner. With a horizontal shaft in an open chamber, several runners can be coupled together, all of which are easily examined, when the inlet chamber of the turbine in question is shut off from the forebay by closing the sluice gates. It is possible with this arrangement to obtain the greatest speed of the turbine, and thus reduce the cost of the electric generator.

Considering the construction work necessary in the power house, the horizontal shaft has again the advantage over the vertical, because the bottom of the tail-race need only be sufficiently deep to prevent excessive velocities in the issuing water, while in the vertical arrangement, especially with multiple runners, the foundations have to be carried down much deeper. The disadvantage of the arrangement lies in the greater breadth of the power house and turbine chambers, and this may under certain circumstances outweigh the extra cost of the deeper foundations necessary for the vertical shaft. The great pressure against the main wall of the power house is also inconvenient when the head is considerable; the wall must therefore be constructed in a very substantial manner, and dampness cannot of course be prevented. From the point of view of the turbines, there is a disadvantage in that they cannot be served by the crane of the generator room, and that considerable difficulties present themselves when replacing turbine parts in spite of the greater accessibility. Turbines with a vertical shaft can, however, be lifted out with the power house crane, as soon as the rotor of the generator is removed.

The engineer who is designing the plant can only decide which is the most advantageous arrangement for a given case after an exhaustive examination of all these points, and this is some of his most difficult work. In the case under consideration, there is no doubt that the horizontal shaft is to be preferred.

The net head in this plant varies, as already mentioned, between 9.27 metres with the lowest, and 7.7 metres with the highest water level in the river. Units of 1500 h.p. each were required, having the greatest possible speed and maximum efficiency. As the total quantity of water available varies from 80 to 120 cub. metres per sec., the plant was arranged for seven units of this size. The speed was fixed at 150 revs. per min.; turbines with four runners were therefore necessary to satisfy the condition for greatest possible efficiency. The turbines had to be constructed of such a size that the full output of 1500 h.p. at normal speed could be obtained with the lowest fall of 7.7 metres; this represents a volume of water of nearly 19.5 cub. metres per sec. each.

Fig. 9 represents a longitudinal section of one unit, and clearly shows the arrangement of the turbine and of its generator. The turbines are built each in an open chamber, which can be shut off from the forebay independently of any other unit. The height of the centre of the turbine shaft above minimum tail-race level is 5 metres. In order to sim-

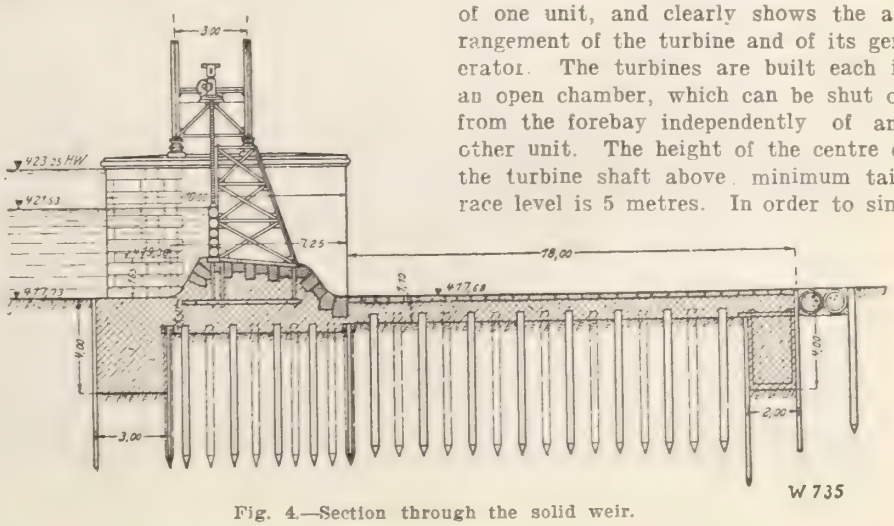


Fig. 4.—Section through the solid weir.

plify the construction of the tail-race, the draught tubes of the turbines were made of sheet iron, as shown in fig. 11, slightly inclined towards the tail-race, and dipping freely into the water. These draught tubes are firmly built into the substantial concrete arch, forming the bottom of the turbine chamber, and carrying the two draught tees, to which the draught tubes are fixed, and which support the guide wheels and bearings of the turbine. The turbine and generator shaft is placed at such a height that the highest possible back-water level cannot reach the lowest part of the generator; these machines are thus perfectly secured against flood. Each generator is connected to the turbine shaft by a flexible coupling of the Zodel type. The turbine shaft is in two parts; the first extends from the Zodel coupling to the centre of the two twin turbines of which the unit is formed; the other part extends from the centre to the end of the second twin turbine, and is connected to the first by a solid flange coupling.

Each part of the turbine can thus be dismounted separately, since the rear twin turbine can be completely disconnected from the one in front. There may be times of unusually low water, when this would be an advantage also when running, in order to obtain maximum efficiency. The turbine would then run with half its wheels only. Each twin turbine has two bearings, and there is another bearing in the generator room next to the coupling. There are therefore three bearings in the water chamber, and, to enable these to be of the usual type with self oiling rings and to be accessible at all times during running, a steel housing has been provided, enclosing each, and made accessible through a vertical steel plate well, which passes up to the floor carrying the sluice gates. All bearings are thus perfectly dry, and can be examined at any time. The chamber in which each turbine is placed has a clear width of 6 2 metres, and a total length from the gates to the power house wall of 11.7 metres. The chamber is narrowed slightly from about half its height downwards, so as to allow for sufficient thickness of the partition walls. The latter are 1.83 metres thick at the top, and increase to 4 metres at the bottom. There is nevertheless ample room for

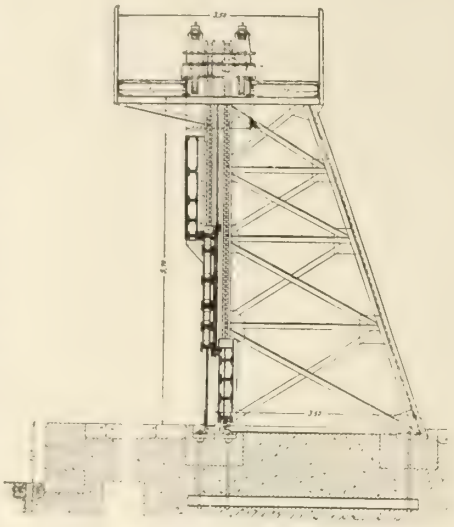


Fig. 6.—Sluice gates at entrance to canal.

getting round all sides of the turbine, and for dismounting, or effecting any repairs, since the turbines have been specially constructed in a very compact form. The side walls of the tail-races are 1.8 metres thick, and are considerably thickened at their base. They traverse the whole width of the power house, and extend so far beyond it on the down stream side that each individual race can be completely shut off by timber panels fitted between the walls. The main power house wall, which has to withstand the thrust of the water is 2.5 metres thick at its thinnest point.

Fig. 12 shows the power house during construction, as seen from the down-stream side; the individual tail-races from the turbines are clearly visible with their substantial partition walls, which also support the main portion of the power house.

Turbines Selected.

The turbines are self-governing Francis type, with pivoted blades in the guide apparatus. Two wheels discharge into a common exhaust pipe, formed by a large cast iron draught tee, which is divided horizontally into two parts, so that the upper can easily be removed, and the turbine thus laid open for inspection. There are also two manholes in this cover Each draught tee pipe is bolted to a massive draught tube of steel plate of rigid construction, which is grouted into the tail-race arch, and securely held in the concrete by angles riveted round its circumference. The front guide wheel, next the generator room, is carried by a massive cast iron wall-plate grouted into the concrete wall.

Fig. 13 is a photograph of the complete turbine group, showing the heavy wall-plate and front bearing, the exhaust pipes, the bearing chambers with their inspection wells, and the method of supporting the two regulating shafts which operate all the guide apparatus. The runners are 1.3 metres diam. over the tips of the blades, and are 0.325 metres deep at the inlet, but increase in depth towards the outlet edge. The outside diameter of the runners at their outlet is 1.4 metres, so that they can be removed, as soon as the guide blade cover has been lifted off, by simply sliding along the shaft, and without disturbing any other parts. Partly for this reason and partly in order to obtain the maximum possible efficiency, the makers preferred not to use the so-called high speed type of runner which would have necessitated broader inlets and wheels of

Fig. 7.—View of power house from the tail-race.

larger diameter. Each runner is made with 15 blades of 8 mm. steel plate.

The guide wheels each have 20 blades, which are movable about fixed pins; a complete turbine has therefore 80 guide blades. These movable guide blades are connected by straps with the guide ring which is in turn connected by levers with the two regulating shafts, placed diametrically opposite each other, one on each side of the turbine. Any movement of the two shafts is transferred equally to all the guide blades at once. These regulating shafts pass through the wall-plate into the generator room, and terminate in two gear wheel segments, engaging with a rack at the end of the servo-motor piston rod. This servo-motor piston is moved with pressure oil, thereby setting the whole of the guide blade apparatus in operation. Fig. 10 gives a general plan of this arrangement.

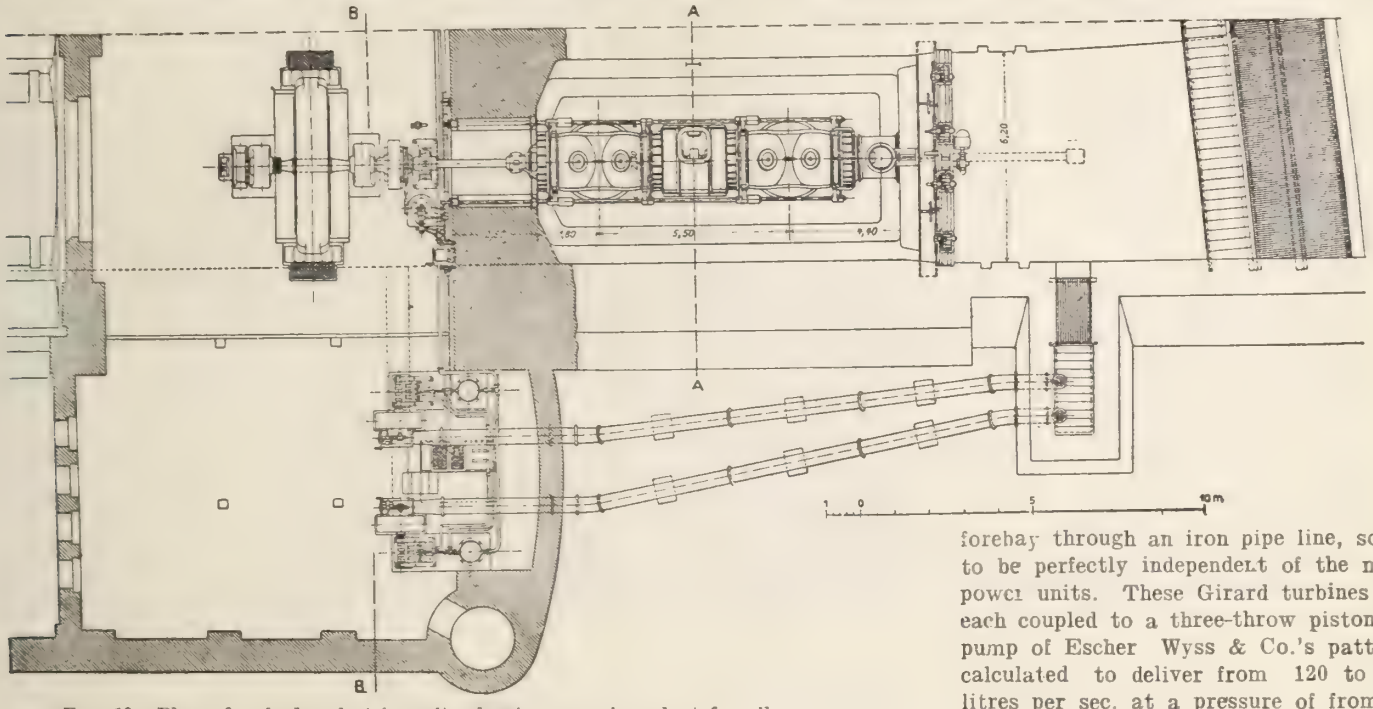


Fig. 10.—Plan of a hydro-electric unit, showing pumping plant for oil pressure governors.

Oil Pump Equipment.

The pressure oil required for the governors is provided by pumps, which are placed at the end of the power house. This pumping plant consists of two Girard turbines with horizontal shafts, and supplied with water direct from the forebay through an iron pipe line, so as to be perfectly independent of the main power units. These Girard turbines are each coupled to a three-throw piston oil pump of Escher Wyss & Co.'s pattern, calculated to deliver from 120 to 150 litres per sec. at a pressure of from 20 to 30 atms. Each pump is connected to an air vessel, which in turn feeds the system of oil pressure pipes leading to the delicate hydraulic governor on each turbine. Between the two pumps, large oil tanks have been arranged which store and filter the used oil, and from which the pumps draw their supply. These two oil pumping units are amply sufficient to operate the governors of all seven main turbines. A third pump, driven by an electric motor, has been added as a reserve unit.

This arrangement of the oil pressure plant has been found extremely satisfactory, in spite of some unavoidable dis-

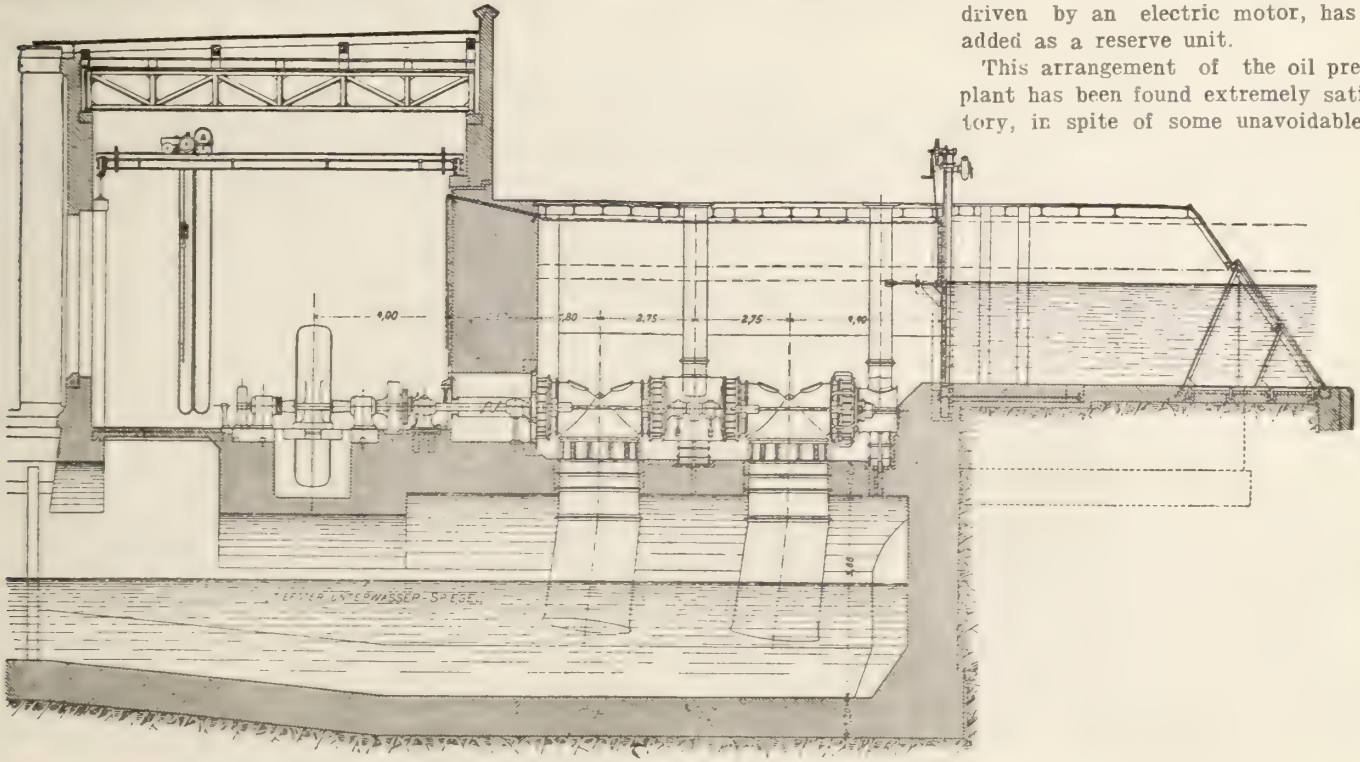


Fig. 9.—Section along axis of turbine unit.

advantages of a pumping installation; the main points in its favor being its absolute independence of the main power units, the great accessibility of the plant, and the comparatively small space required. The pump turbines are

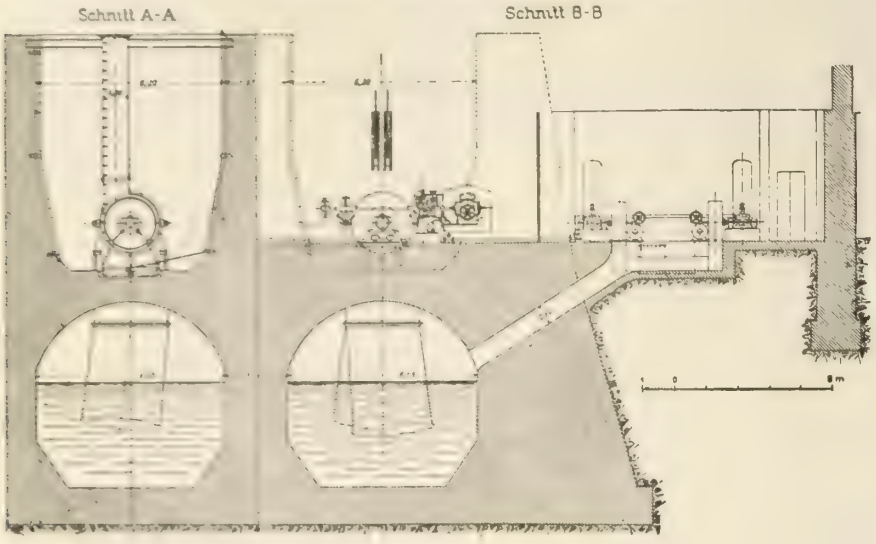


Fig. 11.—Cross section. Scale 1:200.

so constructed that a considerably greater oil delivery can be obtained by increasing the speed, in case it should be necessary. Under normal conditions, the turbines and pumps run at 60 revs. per min., a figure which may be increased with ease, as already mentioned above. High pressure oil from the pumps is admitted to the servo-motor cylinder of the turbines by the well known governors of precision built by Escher Wyss & Co. The governors themselves are driven from the turbine shaft with double belts. For a section showing the arrangement of these parts, see fig. 11

The Power House.

Fig. 14 represents a general view of the power house, showing three of the generators, the switchboard, and the governors with their method of drive. The exciters are coupled directly to the shaft of each unit. The separate penstock chambers for each of the turbines can be closed by two sluice gates, operated either by hand or by electric drive. There are also slots for timber panels provided in the wall in front of the sluices in case they should be needed at any time during repairs. The framework supporting the sluice gates is constructed of T and U sections rigidly anchored in the masonry. The average depth of water in front of the sluices is 4 metres, but may rise to 4.6 metres. A grating is provided stretching across the forebay along the whole length of the power house. As the velocity of the water through the turbine chamber penstocks may rise to as much as 1 metre per sec. at times of lowest canal water level, it was necessary to keep the net area through the grating as large as possible, so as not to cause appreciable loss of head; the partition walls between the turbine chambers were therefore tapered off towards the forebay, and the clear passage for the water here-by increased at the gratings. The gratings are 4.5 metres high, and the floor for cleaning them 0.5 metres above maximum high water level. It was therefore necessary to fix a solid partition from the top of the grating to the floor level :—See fig. 9. The total length of grating is 54.35 metres. With a total flow of water of 100 cub. metres per sec., which is increased to 0.8 metres per sec. with six turbines running, and a depth of water of 3 metres, the velocity at the grating is only 0.7 metres per sec. through the bars, owing to their thickness and the consequent reduction of the net area. Since the direction of flow is almost exactly parallel to the face of the bars, no appreciable loss of head is caused, in spite of this somewhat high velocity.

Fig 3 gives a general view of the forebay, while the detailed arrangement of the grating is seen in figs. 8, 9 and 10. A spillway was arranged at the opposite end of the power house to that where the pumping plant was installed. This spillway was built exactly the size of the chamber for a turbine, and was used later to install the seventh unit, which completed the plant. The spillway was then re-built beyond the new unit. It is used for freeing the forebay of ice or rubbish.

The power house is 58 metres long, without counting the space for the pumping plant. The width of the generator room is 11 metres. The height from the floor to the crane rails is 7 metres, and to the under side of the roof 10.5 metres. Great care was taken in the architectural design, as may be seen in the view from the tail-race, fig. 7. The front of the building towards the river is an example of the taste which has been shown in the designs, and is a decided asset to the beauty of the river scenery. The Wangen power station is claimed to be one of the finest and most imposing of Swiss water power plants. Since the minimum flow of 80 cub.

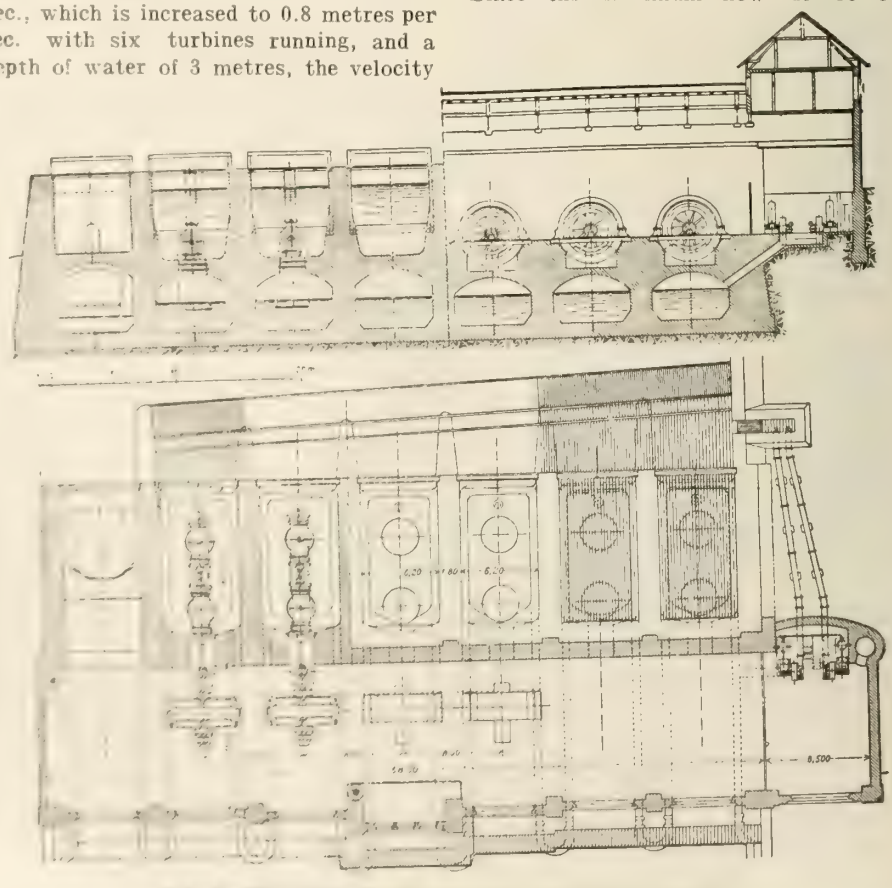


Fig. 8. The power house, plan and longitudinal section.

metres per sec. only occurs during very short periods, the station can supply the full 9000 h.p. almost the whole of the year.

As was already mentioned at the beginning of this article, the whole plant

Fig. 12.—The power house during construction. View of tail-race.

was built by the well known firm Elektrizitats-Aktiengesellschaft, late Lahmeyer & Co., of Frankfort on-M., who supplied all the electrical equipment and transmission lines. The river and canal construction work was undertaken by the Basle firm of contractors. A. Buss & Co., and the turbines were built by Messrs. Escher Wyss & Co., Zurich, Switzerland.

THE TRANSVERSE CURRENT WATER HEATER.

The apparatus shown herewith is known by its builders as a "Transverse Current Water Heater." It may operate as an ordinary feed water heater, using the exhaust of a steam engine, but it has been especially adapted to the heating of water for shop, laundry, hotel or other purposes from the exhaust of a gas engine. It is believed to be the first commercially successful device for this latter purpose, yet placed on the market. As is well known, only a comparatively small percentage of the heat of the gas used, in generating power in the gas engine, is changed into work. The balance is wasted through the exhaust and water jacket. The exhaust has a temperature of from 800 to 1,200 degrees Far., and this heater is designed to save all of this heat that is possible. It has been found that with an engine using 15 cubic feet of gas per hour, nearly two-thirds of the total heat is, thus, made available. Further, it has been calculated and found from experience, that, allowing for loss from radiation, etc., one of these heaters will raise the temperature of nearly 6 gallons of water from 40 to 200 degrees per hour, for each engine horse-power developed.

Detail Arrangement.

The heater, as may be seen in Fig. 1, consists of a series of flat rectangular passages, of sufficient number to give the required heating surface. These are so arranged in connection with the inlet and outlet openings at the end, that the exhaust enters the heater at the top, passes through a sufficient number of these passages or ports to avoid back pressure, and then turns backward again; passing through from side to side, three to five times before reaching the exhaust outlet located at the bottom.

The water enters the heater at the bottom, passes over the first port, back over the second, over the third, back over the fourth, etc., from bottom to top. This back and forth movement is controlled by the circulation plates. The water thus goes through but one passage at a time, traveling upward and across, in an opposite direction to the exhaust. In this way, the hottest water, just as it leaves the heater at the top passes through the section heated by the hottest exhaust. The entire heating surface is, thus, effective, and as the water is constantly agitated, the maximum amount of heat is absorbed.

As a feed water heater operated by exhaust steam, this device has the advantage of being made entirely of cast iron, which does not easily corrode, and is not readily affected by electrolysis or acids. As the result of this precaution, the life of the heater is, of course,

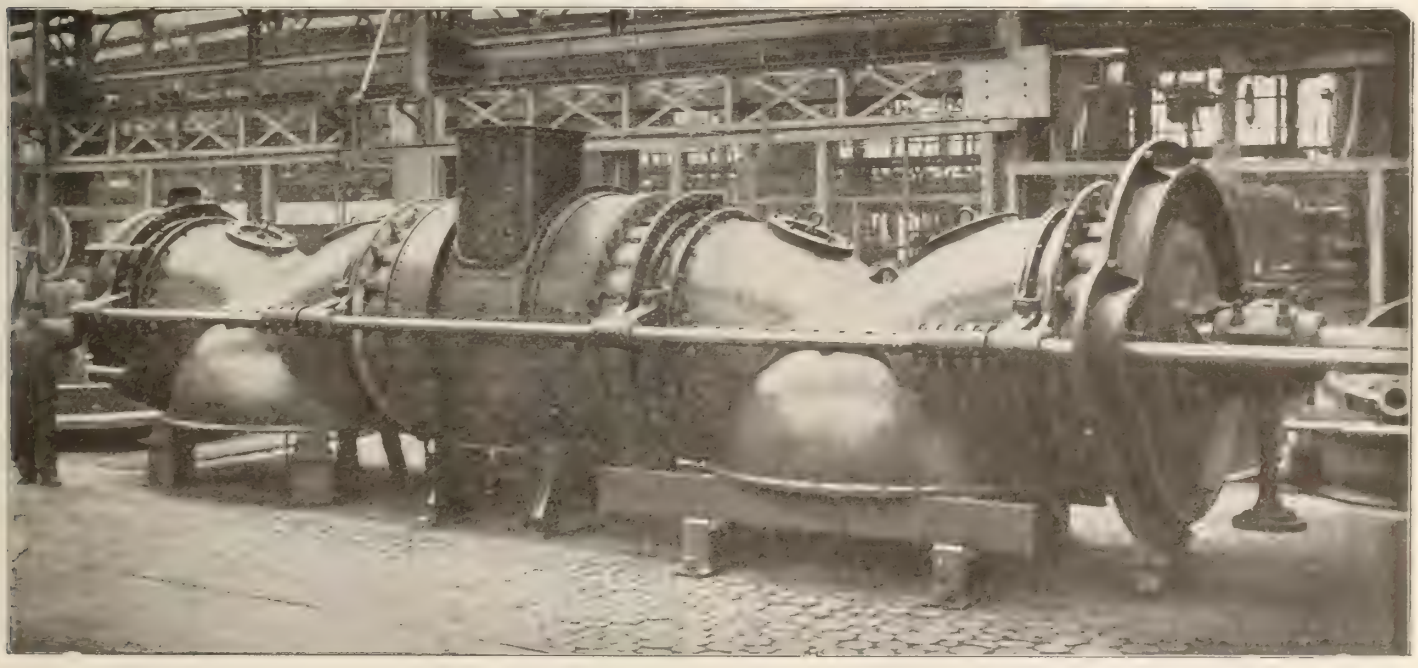


Fig. 13.—View of complete turbine unit for the electric station Wangen-on-the-Aare.

greatly prolonged. There are no tubes to collect scale, no internal joints to leak, and the water does not come in contact with the exhaust.

This heater has been tested and proved in many installations operating with both steam and gas engines; the results in both classes of service being highly satisfactory.

Fig. 14.—View of generator room at Wangen-on-the-Aare.

Comments on a No. 8 Heater Test.

Mr. John T. Farmer, Consulting Engineer, Coristine Building, Montreal, makes the following observations and comments regarding the tests conducted by the Westinghouse Machine Co., of a No. 8 Transverse Current Heater built by the Standard Engineering Co., 14-16 King Street E., Toronto, the Canadian Licensees and Sales Representatives:

"Natural gas was used, the principal constituent being, of course, Marsh gas. Its specific weight has been assumed to be that of the latter in its pure state:—.0422 lbs. per cub. ft. at 62 degrees F., and 30 inches Hg.

The temperature of the gases at exhaust from the engine and as delivered to the heater are not given in the test results. To arrive at those temperatures from the data given, it is necessary to know the weight of the exhaust gases. But this is also lacking. The theoretical amount of air necessary for the complete combustion of Marsh gas is 14 lbs. per gas pound, and this quantity would hold very closely for natural gas. It would appear that a 50 per cent. excess of air would probably be taken, but as will be seen, this assumption gives high values for the exhaust temperature.

Test No. 1—Full Load.

Heat available in gas supplied:—
2,175 × 966 = 2,101,050 = 100%.
8,175 × 84 = 686,700 = 32.6%.
Heat from Heater:—
8,175 × 58 = 474,150 = 22.5%.
Heat in work output:—
201 × 2,545 = 511,545 = 24.4%.
Balance of heat = 428,655 = 20.5%.
Cooling water used per hour=8,175 lbs.

Weight of gas supplied=2,175×.0422= 92 lbs. Weight of exhaust gases= 92 × 21 (14×1.5)=1,932 lbs. Heat in exhaust gases from Heater=1,932×.24× (267—40)=105,500=5.0%. This leaves unaccounted for inradiation, etc., 323,155 =15.5%. Heat in gases at exhaust before entering heater = 474.150+105,-500=579,650=27.5%. Hence temperature of exhaust gases=

$$\frac{579{,}650}{1{,}932 \times .24} + 40 = 1{,}240 + 40 = 1{,}280 \text{ degs.}$$

A greater excess of air must have been used, as 100% excess would give an exhaust temperature of about 1,040 degs. Fah.

Heat Absorption of Heater.

Riblet Heater No. 8 contains 134 sq. ft. of heating surface.

T_1=Temperature of entering gases= 1,280 degs. F.

T_2=Temperature of exhaust gases = 267 degs. F.

t_1=Temperature of entering water = 132 degs. F.

t_2=Temperature of delivered water = 190 degs. F.

$\frac{T_1+T_2}{2}$=773 degs., $\frac{t_1+t_2}{2}$=161 degs.; and 773—161 = 612 degs., therefore

$$\frac{474{,}150}{134 \times .24} = 5.75 \text{ B.t.u. per degree difference between water and gases per sq. ft. of heater surface per hour.}$$

This seems high.

If the excess air is greater and the available temperature less, the absorption coefficient would work out still higher.

Test No. 2—Half Load.

Heat available in gas supplied:—
1,411× 966=1,363,026=100%.
Heat from Jackets:—
5,050× 93=469,650=34.5%.
Heat from Heater:—
5,050× 56= 282,800=20.8%.
Heat in work output:—
100.8×2,545= 256,536=18.8%.
Balance of Heat=354,040=25.9%.

Cooling water used=5,050 lbs.. Weight of gas supplied per hour 1,411×.0422= 59.54 lbs. Weight of exhaust gases= 59.54×21=1,250 lbs. Heat in exhaust gases=1,250×.24× (217—40) =53,000 =3.9%. This leaves unaccounted for,

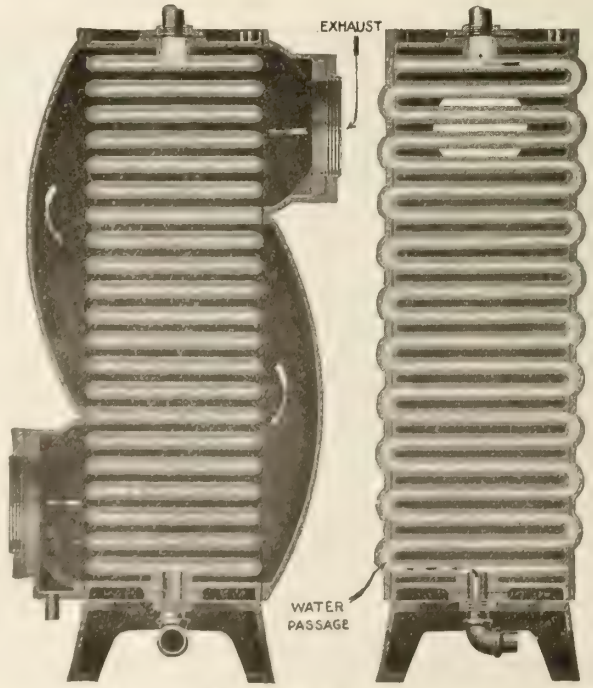


Fig. 1 Transverse Current Water Heater adapted for use with Gas Engine Exhaust, as well as with Steam.

due to radiation, etc., 300,940=22.0%. Heat in gases at exhaust before entering heater=282,800 + 53,000=335,900= 24.7%. Hence temperature of exhaust gases=

$$\frac{335{,}900}{1{,}250\times.24}+40 \text{ degs.}=1{,}120+40=1{,}160 \text{ degrees.}$$

T_1=1,160	t_1=140
T_2= 217	t_2=196
2|1,377	2|336
T= 688	t=168

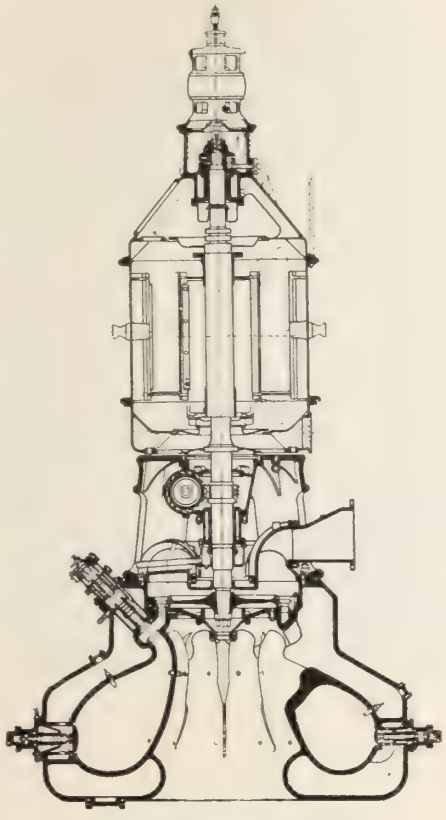
$T - t = 688 - 168 = 520.$

Heat absorption of heater $= \frac{282{,}800}{134\times520}$ =4.05 B.t.u. per degree difference between water and gases per sq. ft. of heater surface, per hour.

THE GAS TURBINE*

By Herr H. Holzwarth.

AFTER briefly sketching the system as applied to the gas turbine, in which, he said, a mixture of gaseous fuel and air, or of fluid fuel and air was caused to burn, and its inherent energy set free in such a manner that the gaseous product of combustion became subject to the highest possible pressure; the excess of the latter over the atmosphere being then made use of in the turbine proper, the author drew a comparison between this motor and the engine and boiler of the steam turbine installation. Under the highest combustion pressure, the gas air mixture was, in the Lemale gas turbine, introduced into the combustion chamber and there continuously burnt. The outlet from the chamber took the form of a nozzle, through which the product passed at high velocity, to be then used in driving the turbine. The combustion chamber thereby became very hot, and had to be cooled by enclosure in what was practically a steam boiler. The other possible solution of the problem—that of the explosion turbine —had been adopted in the Holzwarth-Junghans turbine. A sketch of



1000 H.P. Holzwarth Gas Turbine.

a 1,000 horse-power suction-gas turbine was given.

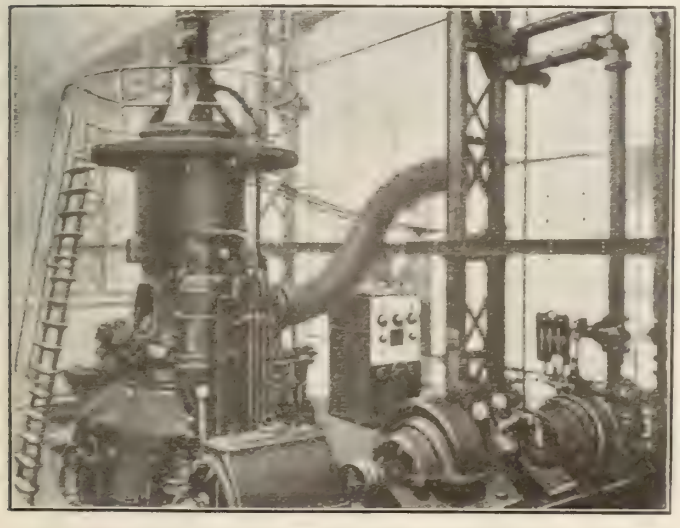
The arrangement took somewhat the form of a lantern-like tower about 10 ft. diameter by 21 ft. in height, with a broad base containing the combustion, air and gas chambers and their appurtenances. These were in several sets in the round, each with a nozzle at the top through which the product of combustion passed to the horizontally rotating turbine wheel and thence to the exhaust. Above the ring of exhaust outlets, was arranged the dynamo with its central vertical shaft hung from the top and passing through the turbine cover without a stuffing-box. The chambers belonging to the explosion process were of ellipsoid or similar form, so as to be able to withstand the pressures on the least possible weights of material. The weight of these chambers was given as about 17 tons and that of the gas turbine at about 25 tons, an equivalent reciprocating gas engine without flywheel being referred to as weighing about 140 tons. The valve arrangement was worked by pressure oil instead of by mechanical means as in the reciprocating engine, a horizontal shaft in the tower section below the dynamo actuating the appliances which distrirbuted the pressure oil at the right time to the various valves. Sketches of a horizontal plant of the same power were also shown, and general plans of an actual installation including it, which is being constructed by Brown, Boveri & Co., of Mannheim.

Experiments with different gases showed that, to ensure ignition at proper and regular intervals, the temperature of the exhaust chamber had to be varied. For petroleum, gas oil, and coal-tar, the suitable temperatures were 400 deg., 440 deg., and 375 deg. respectively. Further, the correct fashioning and dimensioning of the nozzles was found to be of the highest importance to the smooth working and efficiency of the motor. The accompanying illustrations and supplementary notes are from Herr Holzwarth's book.

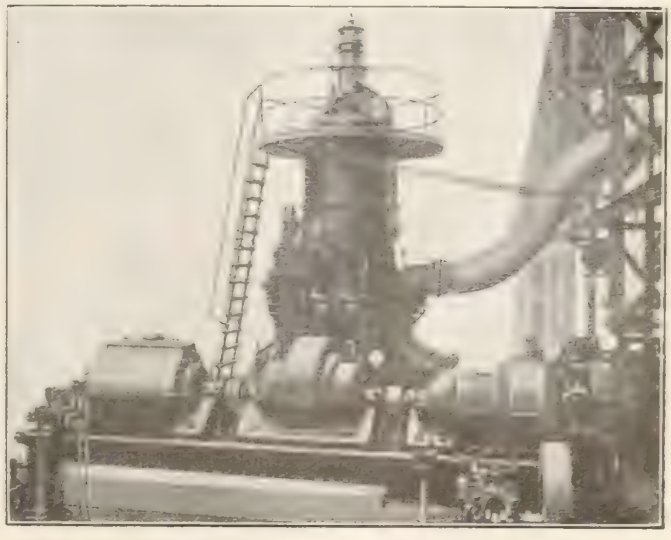
Operating and Constructional Features.

The turbine can be constructed in either a vertical or horizontal form, but the first machine, illustrated herewith,

*Abstract of a paper read before the German Institute of Naval Architects.



1000 H.P. Holzwarth Gas Turbine.



1000 H.P. Holzwarth Gas Turbine.

is vertical. The pear-shaped gas chambers are below, forming a base, which carries the dynamo, etc. The turbine wheel is keyed to the end of the shaft, which is carried entirely from above. A horizontal shaft driven by spiral gearing from the main shaft operates the governor, the safety gear controlling the ignition, the tachometer, the ignition gear, and a valve which controls the supply of oil to operate the valve gear. All the valves are placed on the explosion chambers, which, it will be observed, are arranged in a ring. The air and gas valve is placed at the lower end of each chamber, while at the upper end is a valve operated by pressure oil, which closes the passage to the jet during the entrance of the explosive mixture.

The air and gas are maintained at a small pressure in the spaces surrounding the explosion chambers, but are kept apart. The section shows on the left side an air valve, and on the right a gas valve. The former, it will be seen, opens to the upper part, and the latter to the lower part of the external casing. Both valves are controlled by oil pistons. The cycle is as follows;—A mixture in any one chamber is fired electrically, and the pressure created lifts the nozzle valve and permits the gases to impinge on the turbine wheel. As the pressure falls, the valve closes under the influence of the spring, but controlled by the oil cylinder. Before complete closure, air is admitted, expelling the burnt products and partly cooling the wheel. When the valve is closed, gas in the proper quantity is admitted, and the cycle is repeated. The turbine illustrated develops about 1,000 horsepower at 3,000 revolutions, and was made by Brown, Boveri & Co.

Query and Answer.

Professor Krainer said he should like to put only one question to the author It was well known that extensive experiments had been made during the preceding year with the gas turbine, and that certain noteworthy results had been obtained :—He would like to know of what material the blades were made for these high temperatures, and further, what efficiencies were obtained and how the blades were attached.

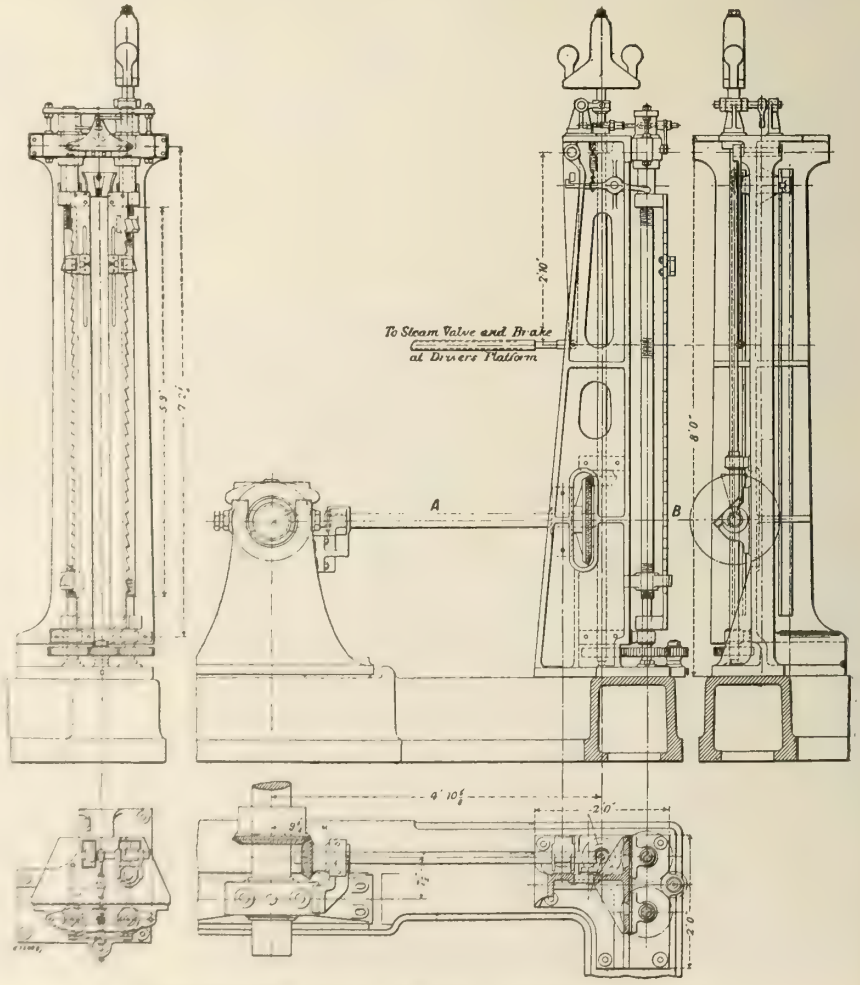
Herr Holzwarth said the question with regard to the material of the blades and the experiences obtained with them was very easy to answer. In the case of the first turbine, they formed the blades out of the disc itself, the material being nickel steel. They had observed no pitting. Subsequently, however, they [illegible] ordinary steel, and that for the [illegible] was made by electrolytic means; in other words it was electro-steel. They [illegible] temperatures of 500 degs. [illegible] Brown, Boveri, they attached the blades by a dovetail arrangement. They found, after a considerable term of service, that these had not become loose.—The Engineer.

LARGE CORLISS WINDING ENGINES.

A RUNNING test was carried out recently at the works of the Sandycroft Foundry Co., Chester, England, on one of a pair of large Corliss winding engines built for the Champion Reef Gold Mines, Kolar Goldfield, Madras. These engines are designed and constructed to wind from the same vertical shaft, the depth of which is 3,700 feet. The speed of winding is 3,000 ft. per minute, the unbalanced load being 15.5 tons, and the steam pressure 120 lbs. per sq. inch, superheated. The valve gear is of the improved "Corliss" type and is placed on the outer sides of the engine. The cylinders, 42 in. diameter, with a stroke of 7 ft., have separate liners and are steam jacketed ; each body is cast separately from the two end pieces, which carry the valve chambers. The pistons are fitted with metallic packing rings, the outward pressure of which is adjustable. The piston rods are 8 in. diameter, and are fitted with U.S. metallic packing.

The crossheads are of steel with cast iron adjustable slippers, a special feature being the method of attaching the piston rods. Each rod passes through a steel plate, and heavy nuts on the rod, one on either side of the plate, secure it in position. The plate is bolted to the crosshead by four bolts. This permits of being able to adjust the distance between the centres of the piston and crosshead with ease, when connecting or disconnecting the latter from the piston rod. The guides are of circular form 41 inches diameter.

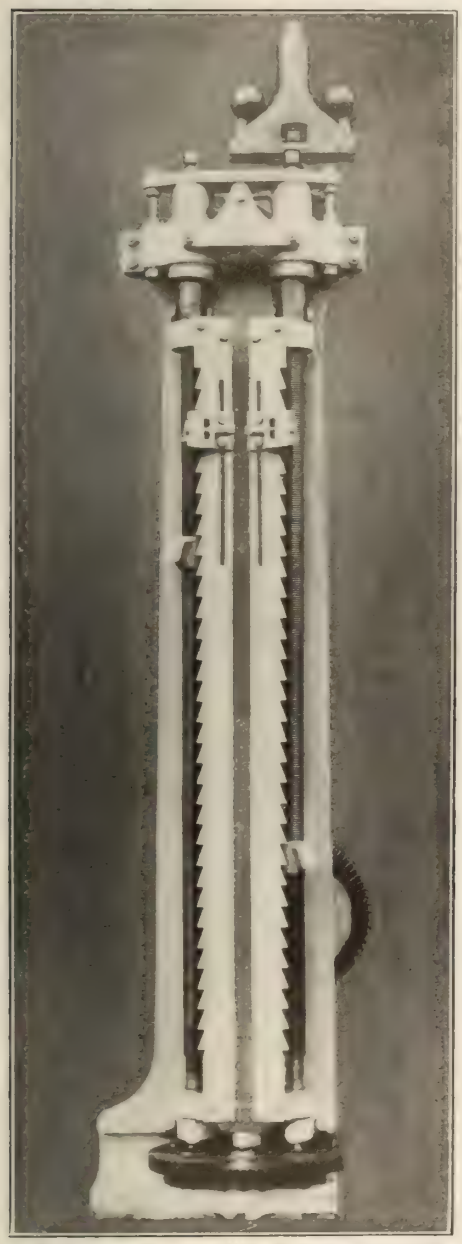
The beds are of massive design, being of the "mammoth" type, and the drum-shaft bearings, 21 inches diameter by 33 inches long, which are cast with them, have the steps lined with special white metal. The connecting rods have screw and wedge adjustment at both ends. A special feature in the design of the crank discs is that they are each made in two pieces. They are 9 ft. 2 in., diameter, the centre hub being separate and having a flange cast on one end of it. The disc itself is bored to fit the hub to which it is keyed, and it is also bolted to the flange. This makes it very secure and has the advantage of reducing the weight and overall dimensions of the drum-shaft for transport, as the discs can be sent away separate from it. Disc brakes are provided, operated from the driver's



Gott's Controlling Gear — 5,500 H.P. Corliss Winding Engine.

platform by foot, hand wheel and screw. The drum-shaft is 25 inches diameter, and its over-all length, 27 feet.

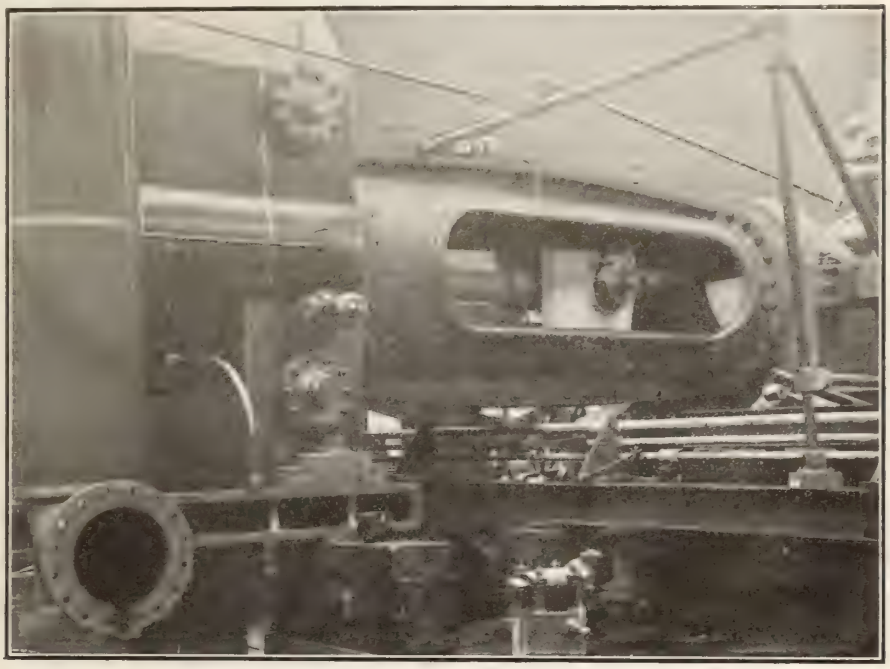
The drum is of the cylindro-conical type, of cast iron, built in sections. The conical part is grooved for 1¾ in. diameter rope, the cylindrical part, which is 20 ft. diameter, and 8 ft. 9 in. wide, being plain. Two small internal drums



5,500 H.P. Corliss Winding Engine—Detail of "Gott's" Controlling Gear.

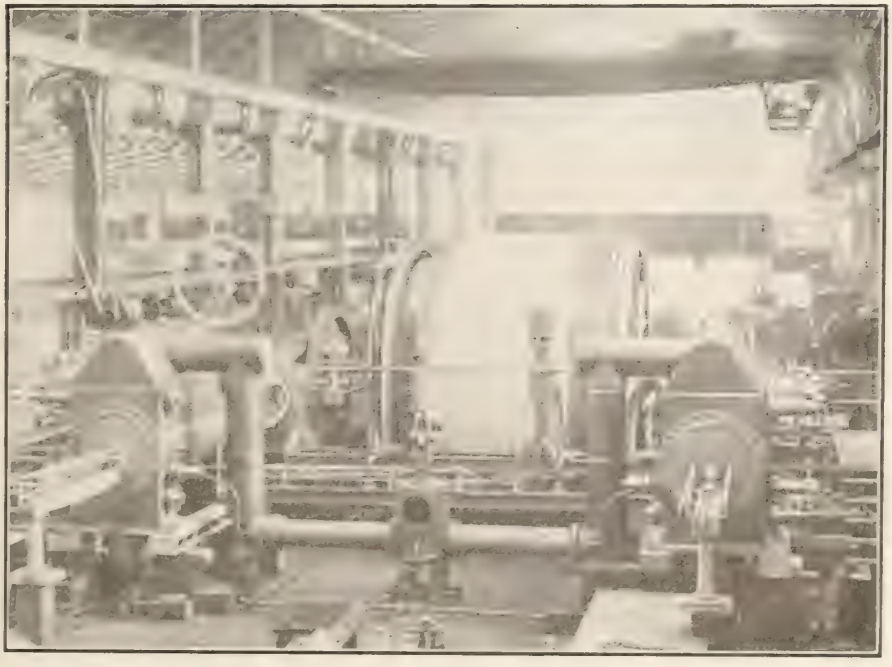
are fitted inside the main drum for carrying spare rope, which can be payed-out as required. There are two main brakes of the suspended curved post type, power being applied to both ends of the posts. They are operated by a steam brake engine, the brakes being put on by means of a weight, and held off by steam. Steam can also be put on the top side of brake engine piston, if extra brake pressure is required. The brakes are adjusted automatically, as wear of the blocks takes place.

The reversing of the engine is done by means of steam reversing gear, having an oil-locking and controlling cylinder. The main steam valve, 18½ inches diameter is of the single beat type, the valve being balanced by a steam piston for ease of operation. The driver's platform is situated on the left hand side of the engine, and has all the operating levers fixed conveniently on it. The governor is of the spring loaded high speed type and of powerful control, while special attention has been given to lubrication of the various surfaces.



Detail of 5,500 H.P. Corliss Winding Engine.

The engine is fitted with Gott's controlling gear for preventing overspeed, overwinding, and starting in the wrong direction. In case of overspeed in any part of the wind, the gear automatically shuts off steam and applies the brakes. It also operates in the same way if on nearing the surface the driver has not reduced speed sufficiently to land the cage safely, or if the driver starts his wind in the wrong direction: that is, if he is taking the cage into the headgear instead of down the shaft, the brakes are automatically applied and the steam is shut off as before. The total weight of the engine is 250 tons, the maximum horse power being 5,500.



5,500 Horse Power, Two Cylinder Corliss Winding Engine, built by The Sandycroft Foundry Co., Cheshire, England.

Horse Power Years vs. Kilowatt Hours: Which Pays Best?

By H. E. Kensit, M. Inst. E.E.

The management of industrial enterprises, using electrical power in the manufacture of their product, will find the information contained in this article particularly valuable, showing as it does, by easily followed reasoning and calculations of a simple nature, the procedure to be adopted in discriminating between the two well-known forms of electrical power contract, so as to secure an outlay commensurate with the exacted service.

MANY manufacturers and other power users, when making contracts for electric power, are given the option of taking it at a price per h.p. year or a price per k.w. hour. Few such persons are in a position to decide which system of rating will be cheapest, and the object of this article is to enable power users, unfamiliar with the special technical points involved, to clearly decide which plan will secure them the lowest annual cost. Taking any given schedule of prices charged by an electric power company, there are very few cases indeed in which the supply to a factory would work out to the same annual amount, when charged on the h.p. year or k.w. hour basis, and in many instances the difference in favor of one or the other would be very marked.

There are three phases of the question to consider :—

1. Where a calculation, based on conditions of work that can be foretold with a fair degree of accuracy, shows so large a margin in favor of one or other of the methods, that no probable variation in these conditions would change the result to any considerable extent.

2. Where a similar calculation shows no decided margin in favor of either system of charge.

3. Where a factory has been previously electrically operated, and records of maximum h.p. used and k.w. hours consumed have been kept for a sufficient time and with sufficient accuracy, to show closely the actual conditions of work.

Load Factor.

The three cases will be separately discussed in detail, and as the whole solution centres mainly on "load factor," it is necessary to have a clear and exact idea what is understood by this, and how it affects the subject under consideration.

The term load factor means the ratio between the power, or more correctly, the "energy" actually used and what would have been used during the same period, if the maximum or peak load had been maintained for the whole of that period. It is, therefore, affected both by hours worked and by the relation between the maximum and average power used. In order to get reliable results, the load factor should be taken over a whole year, in order to eliminate varying results at different seasons. It should also take 365 days per year into account, and not working days only, for power, taken on the h.p. year basis, is paid for and may be used every day of the year.

Very brief consideration will show, when power is taken per h.p. year, that the more nearly what is actually used approaches the greatest amount possible to have been taken during the like period without increasing the peak load, the the cheaper does the power become in relation to useful work done, in other words, the load factor is high, and under these conditions, the h.p. year method of charge is the most favorable to the user. It is obvious that if $20 per h.p. year is paid for unlimited hours of use, it is a better bargain if the power is used for 24 hours a day, and 7 days a week, than if it is used for only 9 hours on 6 days a week. Conversely, in the case of a low load factor, where power is used only intermittently, the charge per k.w. hour is likely to be most favorable to the purchaser.

Example of Load Factor.

To give a concrete instance of working out the load factor, suppose a factory, with motors totaling 100 h.p. installed, whose peak load over any appreciable period does not exceed this, but averages 75 h.p.; also that the daily hours of work are nine, and the working days 300 per annum. The total working hours would then be 2,700, out of a year's total of 8760. The load factor, due to average load being less than maximum, would be $100 \times \frac{75}{100} = 75\%$.

The load factor, due to actual hours being less than total possible, would be $8760 \times \frac{100}{2700} = 31\%$, and the actual load factor would equal 31 p.c. of 75 p.c.= 23p.c.

For convenience we may use the formula:—Per cent load factor=

$$\frac{\text{H.P. hours actually used} \times 100}{\text{Peak load} \times \text{total hours per year}}$$

In the present example this will be :—

$$\frac{75 \text{ H.P.} \times 2700 \text{ hours} \times 100}{100 \text{ H.P.} \times 8760 \text{ hours}} = 23\%$$

load factor.

The actual load factors obtained under working conditions with electric drives are always much less than would be anticipated from a consideration of maximum power used and hours worked. This is due to various inherent economies in the electric drive which are now fairly well understood, but which are outside the scope of this article. Electric driving lends itself to accurate measurement of the actual energy or K.W.H. used, and the maximum peak load occurring in a given period.

Load Factors from Typical Factories.

The following list of load factors obtaining in a few typical classes of factories may be of interest. The figures as to per cent of average load to connected motor load (total rated H.P. of motors installed) are taken from a paper read by Mr. E. W. Lloyd before the National Electric Light Association, and check closely with many similar results from other sources. The annual load factor is deduced from this on the basis of a 54 hour week.

TABLE I.

Kind of Work.	% of average load to connected motor load.	Annual load factor if operated 54 hrs. per week = 31% of full time.
Boiler shops	27%	8.4%
Sheet metal	27	8.4
Soap making	28	8.7
Wood working	33	10.2
Machine shops	35	10.9
Furniture	36	11.2
Boots and shoes	43	13.3
Clothing	45	14.0
Box making	45	14.0
Cotton mills	60	18.6
Woolen mills	71	22.0
Average	41%	12.8%

It will be seen that the average load is only about 40% of the rated H.P. of the motors and the average annual load factor on a 54 hour week is only from 12 to 13%. Now, it is quite usual when power is sold on a H.P. year basis to fix the charge on the total rated H.P. of motors connected, and in such a case, it will be seen that the manufacturer is

often only using 12 to 13% of the power he is paying for, and entitled to use.

In other cases, instruments are installed to measure the actual peak load taken, and the charge is made on the highest reading, lasting at any one time from 5 to 30 minutes, according to the schedule of the power company. This is a much more equitable arrangement, and a specified period of even 5 minutes will be sufficient to prevent the momentary excess load, due to starting a machine, from raising the bill above that due for ordinary maximum load.

In such operations as cement-making, refrigeration, pumping, etc., in which there is a steady 24 hour load for most of the year, the annual load factor may be as high as 80 or 90%.

Comparison of Methods of Cost Charge.—I.

We may now proceed to a comparison of the two methods of charge in some specific cases. Reckoning the alternative charges offered to be $25 per H.P. year, based on the rated H.P. of motors installed, or 2½ cents per K.W. hour, and taking first, the boiler shop (table I.) with a load factor of only 8.4%, and assuming it uses 30 H.P., then, on the H.P. year basis the charge would be:

30 H.P. at $25=$600.

For the K.W.H. basis, we must remember that the motor is rated on its output, and the charge for electricity per K.W.H. is made on the input; in other words, the power user pays for the loss in the motor. An average efficiency for motors, from 5 to 50 H.P., may be taken at 85%. One horse power = 746 watts, and 1 kilowatt = 1000 watts, so that $\text{H.P.} \times \frac{746}{1000} = \text{K.W.}$

30 H.P. output at 85% efficiency = 35.3 H.P. input, and

$$35.3 \text{ H.P.} \times \frac{746}{1000} = 26.4 \text{ K.W.}$$

The load factor of 8.4% is due to both intermittent use and varying load, but it introduces no error to assume, for the purpose of this calculation, that the plant worked at full load for very short hours. We, therefore, take the whole percentage off the hours.

$$8760 \text{ hours per year} \times \frac{8.4}{100} = 735 \text{ hours.}$$

735 hours × 26.4 K.W. = 19,400 K.W. hours.

19,400 K.W.H. at 2.5 cents = $485.

The annual saving in favor of the K.W.H. basis is therefore $115 or 24%, and it would probably be safe to make the contract on that basis.

Comparison of Methods of Cost Charge.—II.

Next take the case of the furniture factory with a load factor of 11.2%. Working this out in exactly the same way, we have:—

Annual charge on H.P. year basis=$600

Annual charge on K.W. H. basis=$650.

In this instance it will be seen that the margin is small, and a slight change in the estimated working conditions might throw the balance either way. The manufacturer, where he has the choice of two rates, should, under such circumstances, stipulate, before making a contract for a term of years, that he shall have the option of changing to the other rate after one year's trial. He can then instal his own electrical measuring instruments, and after a year's run will be in a position to decide which rate will give him the cheapest power.

Comparison of Methods of Cost Charges.—III.

Again, take the case of the woolen mill with a 22% load factor. Worked out exactly as before, this shows:—

Annual charge on H. P. year basis=$600

Annual charge on K.W.H. basis=$1275.

Here, the margin in favor of the H.P. year basis is so large that no probable change in working conditions could turn it the other way, and, therefore, no further consideration is necessary.

To simplify the examples, only 30 H.P. has been used throughout, therefore, the totals given are small, but in the case of factories using hundreds of H.P., the annual sum involved may be large, and the question is then worthy of the most careful consideration before making a contract.

Comparison of Methods of Cost Charge.—IV.

Lastly, take the case of a factory which has operated its own electric power plant. If records have been kept of the peak load and K.W. hours used, and of the cost of producing same, then the cost per K.W.H. is known. If it be under consideration to take supply from an outside source on a H.P. year basis, then the price, equivalent to the present cost of producing, would be:—

$$\text{Price per H.P. year} = \frac{\text{K.W.H per annum} \times \text{cents per K.W.H.}}{\text{Peak load in H.P.} \times 100.}$$

To illustrate the foregoing points we have discussed, Table 2, follows: Assuming $25.00 as the price paid per H.P. year, based on rated output of motors installed, and that the average efficiency of the motors is 85%, then this table shows the price per K.W.H. that would be the equivalent of $25 per H.P. year at different load factors.

TABLE 2.

Price Per H.P. Year	Load Factor	Equivalent Price Per K.W.H. in cents.
$25	8%	4.06
25	10	3.24
25	20	1.08
25	30	1.08
25	50	0.65
25	70	0.46
25	90	0.36

Personal

Leo G. Smith has resigned his position as general superintendent of the steel foundry department of the Londonderry Iron and Mining Co., Londonderry, Nova Scotia.

J. A. McCrossan, city electrical engineer, Vancouver, died at the residence of his parents, Mr. and Mrs. Thomas McCrossan, 759 Bute Street. The late Mr. McCrossan had just been given four months leave of absence by the city council, owing to ill health and intended to go to California, but unfortunately his condition became so serious that he was practically confined to bed until his death.

F. A. Yerbury, vice-pres., the Canadian Boving Co., Bay St., Toronto severs his connection with that firm on 31st December. He has accepted an appointment with the Heaps Engineering Co., Ltd., Vancouver, a particularly strong concern who have in project the establishment of large rolling mills, an electric steel making furnace, also a shipbuilding plant, and will manufacture in addition to the products of the foregoing, internal combustion motors for automobile and marine requirements. Mr. Yerbury's name will always be associated with the successful introduction of the Diesel Oil Engine into Canada, and the fact that he has a large personal interest in the Heaps Engineering Co., is sufficient augury of his and its future.

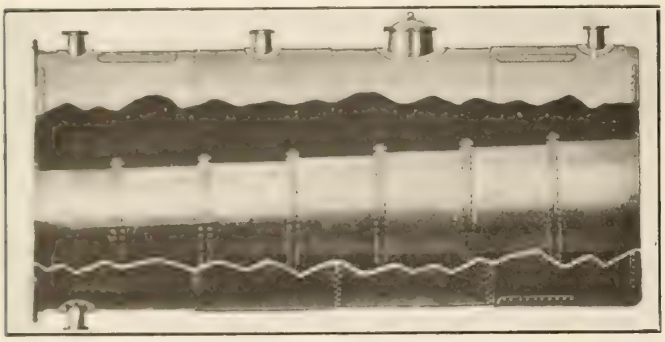
People of our day and generation are very reluctant to admit that they are ignorant concerning any subject. Yet we should never forget that willingness to admit ignorance is a prime factor in developing wisdom and knowledge.

THE YORKSHIRE BOILER

By Calliope.

THE Yorkshire Boiler, illustrations of which accompany this article, is the invention of W. H. Casmey, Leeds, England. While in reality a modification of the well known Lancashire type, it differs materially in internal flue design and length over all, power for power, comparatively. Each flue of the Yorkshire boiler has a fixed diameter for 6 or 7 feet back from the front head, and from this point they expand or taper to

an increased diameter at the rear head. A glance at the cuts showing the interiors of a Yorkshire and Lancashire boiler respectively, will make at once apparent the radical difference with respect to his flue feature. The Yorkshire boiler is claimed to be scientifically correct in design and the makers point to this noteworthy fact in its favor, that the Lancashire boiler, when reversed on its seating, will show an hourly evaporation increase of 10 to 12 per cent., over that attainable with the usual and standard arrangement.



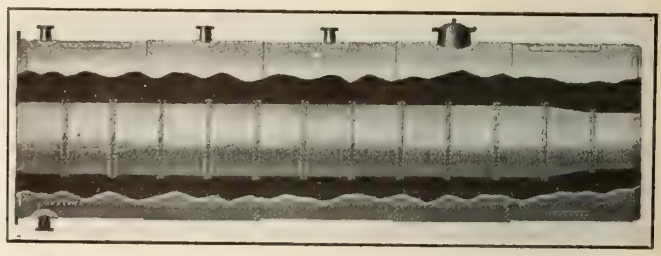
Yorkshire Boiler, Showing Interior.

The front ends of the flues in the Yorkshire boiler are placed as low down as possible, their centre line rising from front to rear. This arrangement allows over the first 7 feet, some 300 or 400 gallons of water to be located in excess of that over the same distance at the rear end. Again, the expanded flues produce a more uniform transference of heat to the water throughout the whole length of the boiler, since, as the temperature of the products of combustion gradually lower, the further they travel away from the grate, the increasing flue section presents a proportionately larger heating surface to a correspondingly diminished volume of water. This type boiler, or a substantial decrease in comparative length, is claimed to be equal to the Lancashire boiler in hourly duty. Further, and in addition, the losses, due to radiation and convection of heat to and through the brickwork, are lessened and the shorter length of the latter, with its fewer joints, reduces the loss from leakage of air to the flues.

The expanded flues tend to safety in the Yorkshire boiler, as the fusible plugs at the rear prevent the furnace crowns being overheated. They also provide means for the gases to escape freely to the external flues, and by doing so, induce an air velocity through the fires, greatly in excess of that through a Lancashire boiler of equal shell diameter. In the latter case, the contracted rear end of the furnace flues acts as a permanent brake to the speed of air passing through the fires, and, therefore, affects the duty and efficiency.

Yorkshire and Lancashire Boilers Compared.

As a comparison, between a Yorkshire boiler and a Lancashire boiler of the same shell diameter, let us assume that both are using the same quality of fuel, and have an equal chimney pull of, say, 1500 feet per minute. This would approximately be the speed of air or gases passing through the smallest sectional area of the furnace flues of each boiler. In the Lancashire, the largest area is at the front, therefore, the smallest at the rear. These positions are reversed in the Yorkshire, therefore, the draught through the fires of the latter, must of necessity be one-third quicker. Owing to the furnace flues in the Yorkshire being reduced in area at the front end, the grates are 17 per cent. less than those of the Lancashire, but as the draught is 33 per cent. greater, it is possible, when desired, to burn more fuel per foot of grate, and with the above mentioned draught, the respective evaporations would be with a 24 x 9 ft. Yorkshire type boiler, 12,000 lbs., and with a 30 x 8 ft. Lancashire type boiler, 10,000 lbs. As long as the percentage of CO_2 and the chimney pull remains the same, the ratio of coal consumption and evaporation cannot change.



Lancashire Boiler, Showing Interior.

The Makers' Guarantee.

The confidence of the Yorkshire Boiler Co., in their product is clearly indicated by the following guarantee :—"We guarantee that a 20 foot Yorkshire type boiler will evaporate as much water per hour as a 30 foot Lancashire type boiler of the same diameter, and that a 24 foot Yorkshire will evaporate 15 per cent. more, while maintaining the same efficiency. We support the above guarantee by agreeing to submit to a penalty of $50 per one per cent. shortage." This indicates that by using a 20 foot Yorkshire boiler in place of a 30 foot Lancashire, a saving in the coal bill of not less than $150 per year can be effected, whilst the adoption of the 24 foot Yorkshire saves one boiler as compared with the Lancashire in a plant consisting of five boilers.

Yorkshire Boiler, Showing Front Head.

Yorkshire Boiler, Showing Rear Head.

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Vol. IV. DECEMBER 1911 No. 12

THE NEW YEAR, 1912.

THE publishers of The Power House extend to its subscribers and advertisers hearty good wishes for an increased measure of successful achievement and personal profit in the coming year, and take this opportunity of publicly expressing their thanks for the continued appreciation of the efforts made to supply a first-class medium through which operators and users are regularly kept in touch with the latest and best developments in every department of power plant manufacture and practice.

At no previous period in the history of The Power House, has the wealth of compliment by reader and advertiser alike been so spontaneously offered and unstintingly bestowed. We are gratified to know that tangible and widespread results, educational and material, are being gained, and backed by an organization and personnel of matured experience we look forward to an eclipse of even the past year's record. We are living in an age when improvement and development are continually in evidence, therefore, we have no hamper or stocking to distribute containing our lay-out of work for the New Year. The editorial and advertising manna will be served fresh, attractively and tastefully each month, and those who participate in its distribution will thereby be assured that they are really cognisant of conditions and equipment as at definite date, 1912.

GRADED LICENSES FOR OPERATING ENGINEERS.

THE question of graded licenses for operating engineers in steam power plants makes little progress in the direction of legislative enactment, and we are forced to the conclusion that a more or less influential, yet probably minority body of individuals connected with the profession are putting up a strong opposition to the proposal.

Complaint is made from time to time that stationary engineers' wages have not participated in that upward movement which has characterized other trades and professions. Let us say frankly, there is justification for the plea, and while the moral uplift of the profession is a laudable aim, the material return to the individual is after all uppermost. Operating stationary engineers, like all others who work for a living, are out to make the most of it, and employers are quite aware of the fact. Again, the management of every manufacturing concern values the several employes at the individual worth or attainment of each. The securing of an operating engineer's license does not impress such management with the idea that the man in charge of their power plant is of more than mediocre ability and attainment. Much blame is put to the credit of employers for their consistent opposition attitude to higher wages for engineers, and in addition, they have been given credit for opposing graded certificates. Increased wages to meet increased cost of living is a live question to the individual engineer, whether a member of the C. A. S. E., other organization or none; statements otherwise notwithstanding, and until the self-contained opposition to graded certificates is fought and well beaten, and legislation put through which will necessitate the successful passing of a series of stiff examinations, and allow the "cream" to come to the top, just so long will employers continue to underestimate the holder of a simple engineer's license.

Journals such as The Power House have been twitted with preaching from the text or standpoint of "Education of Engineers," instead of telling them how to get higher wages. Employers have taken notice of the persistence with which the compaign was carried on, but have failed to perceive its effect on the individual, because he still retained the same old license ticket. The opportunity to get possession of higher grade certificates will be the first real lift of the profession into the limelight of public favor, and to tangible recognition of individual worth by the employer.

MANUFACTURERS CATALOGUES.

With the resumption of Engineers' Society meetings, and the more regular presence of the members in the Lodge Room, there arises a desire for literature pertaining to the power plant equipment and operation, for reference and study. Manufacturers and their representatives should therefore see that the various branches of the different organizations are supplied with this material. Needless to say, results will be found mutually beneficial.

THE ENGINEERING OUTLOOK.

IF appearances are any criterion, the coming year will see brought to a high degree of excellence and reliability such mechanisms of power generation as the steam and gas turbine. Internal combustion reciprocating engines are also being vigorously developed with a view to compassing large powers, and the successful outcome of this application of genius and intelligence is of the greatest moment to all connected with the engineering profession. The revolution in prime movers, which we are now witnessing, has extended to every department of power plant accessory manufacture, and while the transition period lasts, a more or less keen perception is required to adjust old established conditions to the new order of things. The alert manufacturer is keeping pace by rearranging his plant and securing early the right to display some new and necessary auxiliary, and what becomes the manufacturer if he would "hold the fort," becomes also in an equally real sense, those whose business it is to operate.

LIVE STEAM FEED HEATING.

SOME experiments on the old question as to whether a live steam feed heater to a boiler will increase the efficiency of working have been made by Prof. A. H. Gibson, D. Sc., at University College, Dundee, and the results given in a paper read before the Institution of Engineers and Shipbuilders in Scotland. The boiler was of the locomotive type, with shell 3 feet 6 inches internal diameter, 47 tubes, 3 inches diameter, 6 feet 10 inches long; fire box 3 feet 5½ inches by 3 feet 3 inches by 4 feet 8 inches high; effective grate area, 7½ square feet; heating surface, 315 square feet, and feed water supplied by a force pump driven from the crosshead of the main engine.

Heater Operation.

When the live steam feed heater is at work, the cold water enters at the top of the boiler and flows through the heater into the water space of the boiler. The heater was situated actually within the steam space of the boiler, and consisted simply of three shallow tinplate dishes placed one over the other, supported on two longitudinal stays and separated by distance pieces. Feed water admitted to the bottom of the upper dish overflows to the second where a constant depth of about ⅛ of an inch is maintained by a central overflow pipe. The water passes through this pipe into the bottom dish and thence overflows into the water space of the boiler. The size of the dishes were as large as could be readily got into the space, but the author considers that they could have been larger with advantage, as the feed water did not remain in contact with the steam for a sufficiently long time to enable it to attain full boiler temperature before mixing with the water in circulation. By this arrangement of feed heater, the feed water was brought into contact with live steam under the best possible conditions; that is, the live steam and feed water were brought into contact actually within the boiler itself.

Results of Tests.

As a result of four tests, two of which were made with the heater in operation and different loads on the boiler, and two without the heater in operation, a week elapsing between the two series, it was found that the heater improved the overall efficiency of the plant by about 8 per cent. The trials were not commenced until the plant had been running in each case under normal conditions sufficiently long for the state of [illegible] to become normal. The boiler was specially equipped for testing, so that all measurements of fuel burnt, etc. could be accurately made. The steam generated was used to drive an experimental engine loaded with a brake, and which could be varied as desired.

The author considers that probably a conservative estimate would place the increased efficiency as 5 per cent. in the light power trial and 8 per cent. in the heavy power trial, under identical conditions of working, and that it would be reasonable to assume the efficiencies would have been at least 6 and 9 per cent. respectively, if the heater had been sufficiently large to enable the feed to be heated to full boiler temperature.

Reasons for Increased Efficiency.

He gives at some length in his paper, reasons for the increased efficiency. His reasoning, based partly on some experiments, appears to be that the feed water is heated more efficiently by radiation of heat from the steam in the boiler than by conduction of heat through the tubes and plates when the feed is pumped into the lower part of the boiler in the usual way. He accounts for the greater efficiency gain in the case of the more heavily worked boiler as probably due to a greater portion of the heating surface being occupied in heating up feed water rather than in evaporation, when compared with the boiler under light load. He states that such heaters may be expected to be more effective in a given boiler when it is most heavily worked, where no economizer is fitted to take advantage of heat rejected in the flue gases, and where the boiler is fed with cold feed water; other things being equal, in a boiler in which the heating surfaces are somewhat incrusted.

THE DESIGN OF TALL CHIMNEYS.

A PAPER entitled "The Design of Tall Chimneys," by Mr. Henry Adams, was read before the Society of Engineers, London, England, recently.

In designing a tall chimney, he said, it was desirable first to determine the proper height. Forty-five feet was an ordinary height to serve two steam boilers, but in some towns, such as Manchester and Leeds, 90ft. was the least allowed. Chimneys were sometimes proportioned for height according to the coal burnt per week of 56 hours. Thus, for 4 tons per week, they were 75 ft. high; 13 tons, 100 ft.; 26 tons, 120 ft.; 50 tons, 150 ft.; 100 tons, 180 ft.; and for 150 tons, 200 ft. Another rule was to make the height of the chimney three times the length of the boiler plus twice the distance of the furthest boiler to the chimney. This allowed 1ft. of height for every foot the gases traveled round the boiler, and 2 ft. of height for every foot of external flue.

Again, a round chimney should not exceed 25 times its internal diameter in height. In many modern power stations, Babcock and Wilcox boilers and Green's economizers were used; what was saved in obstruction in the boilers was lost in the economizers, so that no material difference arose, but the chimney shafts were as a rule only from 75 ft to 100 ft. high, and of very large sectional area. For chemical works, or in cases where poisonous fumes were emitted, they should be higher than for ordinary steam boilers, in order to disperse the fumes at such a height that they might be diluted to a harmless condition by the time they reached the ground. The Townsend chemical works chimney at Glasgow was 454 ft. high, and was, when built, the highest in the world.

Sectional Area and Wind Pressure.

There were many different rules for the sectional area or internal diameter, some of which depended upon the coal consumption only, others upon the fire-grate area, and others upon the water evaporated in a given time. Simple approximate rules were:—(a) 1 sq. ft. area for each cwt. of coal burnt hourly; (b) area equal to 1-10 of the total fire-grate area, each flue being 1-5 of its fire-grate area, and the main flue ⅛ of total; (c) 2½ sq. in. per i.h.p. of the engine.

Chimney Shape.

With regard to the shape, it was generally acknowledged that circular chimneys had the best appearance, at least above the pedestal, which was usually square, and from which the circular part sprung by broached angles. Octagonal chimneys had the next best effect, some even considering them more sightly than round ones, while square chimneys always looked more or less heavy and were suitable only for short stacks of large area, such as generally used in modern central station work. The circular chimney was most efficient for its area, as it took the least material, and there were no angles in which soot might cling, but with any chimney it was desirable to add 2in. all round to the calculated minimum area to allow for friction. Octagonal chimneys required special bricks for the angles in alternate courses, in order to produce the best work.

Chimneys and Wind Pressure.

The comparative efficiency according to the shape of cross section might also be considered from the point of view of obstruction to the wind; that which offered the greatest obstruction requiring the greatest stability, or quantity of material, apart from other considerations. It is not yet definitely settled what was the pressure of the wind upon a plane surface due to a given velocity, and still less was known of the effect upon a surface inclined to its direction. It would

generally be quite safe, however, to allow for ordinary purposes a pressure of 56lb. per sq. ft. on a plane surface normal to the direction of the wind, and even half of this might be sufficient in many cases. In April, 1902, the Prussian Government issued regulations for the construction of chimney stacks. Square stacks were to be designed for a wind pressure of 25½ lb. per sq. ft. with the centre of pressure at the centre of gravity of diametral vertical plane; octagonal stacks, 71 per cent. of the above pressure, and circular stacks, 67 per cent.

Brickwork.

Up to 150 ft. high or 5 ft. inside diameter, the top length was generally one brick (9 in.) thick; above that height or diameter, the top length should be 1½ bricks thick and the thickness should be increased by a 4½ in. set-off at every 20 ft. below the top. The outlet at top, and the throat or internal diameter at each set-off, should be of the calculated size to give the necessary area plus allowance for friction. Sometimes it was recommended that the top of the chimney should be contracted, to cause the expulsion of the gases at a greater velocity, and so prevent down draught. It was said also that as the gases cooled in their passage up the chimney they required a smaller sectional area to keep the velocity uniform. In general no attention was paid to either of these theories and the section was kept as uniform as the other requirements would permit.

If the diameter of the throat was kept uniform and a 4½ in. set-off occurred at every 20 ft., the intermediate portions being of uniform thickness, a batter of 1 in 53-33 would be given. The London County Council insist on a minimum batter of 1 in 48, and besides that, it would be requisite in most cases to provide a fire-brick lining, for at least the bottom 15 ft. or 20 ft., having a thickness of 4½ in., and a clear space from the outer brickwork of 1½ in. to 2 in. This necessitates a still greater batter. There was also an important rule of the London County Council that "the width of a shaft at the base, if square on plan, must be at least one-tenth, and if circular on plan at least one-twelfth of the total height."

The Firebrick Lining.

The fire-brick lining must be entirely self-supporting and must have a clear space behind to allow for expansion and contraction independently of the main structure. This would be prevented if dirt and dust entered behind. It was therefore necessary to cover the top of the space by an over-sailing course of bricks built out from the inside of the main shaft, to protect the space, but allowing a clearance above the lining of ⅛ in. for every 5 ft. of its height, and permitting of its expansion when heated. No air bricks should be inserted in the outer wall, as was sometimes done with the idea of cooling the air space; any such openings being very detrimental to the draught. The only possible inlet for air to the chimney shaft should be through the fire bars or over the surface of the incandescent fuel. The smoke inspectors of the London County Council had lately recommended openings in the chimney shafts near the bottom so as to reduce the smoke nuisance. The real effect was to dilute the smoke with air before it reached the chimney top so that it was not so black when expelled, but it did not reduce the actual amount of carbon emitted, except so far as it tended to spoil the draught and so to reduce the fuel consumption and boiler efficiency

Materials and Weight.

The weight of each portion of the shaft between each set-off should be obtained separately so that the figures could be used singly or together. The weight would depend very much upon the material. Many chimney shafts were built of ordinary stock bricks and ground stone-lime mortar, and might be taken at 112 lbs. per cubic ft. Others were built of solid machine-pressed bricks and lias lime mortar, and might be taken at 126 lbs. per cubic ft. Some builders preferred perforated radial bricks and Portland cement mortar, weighing, say, about 100 lbs. per cubic ft., while others considered that cement was too unyielding and that a shaft had greater ultimate stability if it swayed slightly in a gale, which they feared the use of cement mortar might prevent. The bond usually adopted was one course of headers to four courses of stretchers, but sometimes tall chimneys were built in English bond, and occasionally in all headers.

The 450 ft. chimney at St. Rollox, Glasgow, was built in old English bond. The 300 ft. chimney at Johnson's Cement Works, Greenhithe, was built in Flemish bond. At Gosling's Cement Works, Northfleet, a 220 ft. chimney was built in stretching bond. At Barker's brick works, Worcester, the 160 ft. chimney was built with three stretchers to one header. At the Surrey Commercial Docks the 110 ft. chimney was constructed with all headers on the circular face, and for the 100 ft. chimney at Farringdon-street Goods Station, Beart's patent perforated radiating bricks were used in the circular shaft, laid with all headers on the external face.—T.E.S.

INSPECTION OF LOCOMOTIVES.

After January 1, 1912, the inspection and testing of locomotives on all the railroads under the jurisdiction of the Railway Commission of Canada will be governed by new and rigid rules which the Board has issued to every road affected.

They provide that companies are to be responsible for the general design and construction of locomotive boilers under their control; that a safe working pressure is to be fixed by the chief mechanical officer of the company or a competent mechanical engineer under his supervision; that the mechanical officer in charge, at each point where boiler work is done will be held responsible for the inspection and repair of all locomotive boilers.

It is ordered that not less than once each month, or fifteen days after inspection, a report of such inspection is to be filed with the chief operating officer of the board for each locomotive used.

In case of accident from failure of locomotive boilers or their appurtenances, resulting in serious injury or death, the company owning or operating the locomotive is required immediately to wire the board's operating officer regarding the accident and the complete list of killed and injured.

A penalty of $100 is fixed for contravention of any of the clauses in the new order.

COST OF PUBLIC WORKS.

Expenditures on Public Works in Canada last year totalled $11,807,055, according to the annual report just issued by the department. How the figures of outlay have grown is indicated in an interesting corporation table. Twenty years ago the total was $2,711,420. Ten years later it was $4,699,680, and last year it reached five times that of 1891. The expenditure for the twelve months was divided as follows; Harbors and rivers, $2,975,059; dredging plants, $4,471,-203; slides and booms, $190,187; roads and bridges, $90,061; public buildings, $3,090,665 ; telegraphs, $568,493 ; miscellaneous, $421,364. The revenue was $537,529.

The report gives a detailed description of harbor improvements in different parts of the country, and also characterizes as feasible the proposed Saskatchewan river waterway. With the expenditure of a million and a half dollars it is believed that the river can be made navigable for small craft and barges between La Pas and Prince Albert.

ELECTRICITY FOR STATIONARY ENGINEERS

ELECTRICAL MACHINERY, ITS CARE AND HANDLING.

By Roderick Grant, Toronto.

IF we leave out of account faults in design, material or construction, breakdowns of electrical machinery may almost invariably be traced to want of attention, and in most cases the trouble starts at the brushes or commutator. It is essential, therefore, that frequent periodical inspection be made, and that all parts be kept scrupulously clean, for faults arising through neglect in this direction develop rapidly. and sooner or later burnt out coils are sure to result. It is our purpose, here, to point out the general precautions to be observed by engineers and attendants in charge of electrical plants.

Brushes and the Troubles Arising Therefrom.

Where a number of d.c. motors are in constant service, it is advisable to have at hand a spare set of brushes of the required size for each machine. The common practice of cutting a brush when required from a large sheet of carbon is not recommended, for in addition to the obvious risk of time being lost while the brush is being fitted, there are other disadvantages to be accounted. It will be found that separately molded brushes have a more even texture and are more free from imperfections such as cracks. It is also possible to have them copper coated, which, not only reduces the resistance, but makes better contact with the holder, thus reducing any tendency to excessive heating. In some brushes, a certain percentage of graphite in their composition reduces the mechanical friction on the commutator. It is essential that the brush should be an exact fit for the holder, as otherwise the area of the surface in contact will be diminished, causing undue heating, and if the holder is of the box type, chattering with sparking is sure to result.

When inserting the brush, the machine, if possible, should be out of gear, with the armature free to revolve. A strip of coarse sandpaper should then be placed under the brush, face upwards, and held close around the surface of the commutator. While the brush is bearing with the normal pressure of the spring on the effective side of the sandpaper, the armature should be moved backwards and forwards until a convex surface is ground in the face of the brush that will bear truly on the commutator surface. The process should then be repeated with a strip of very fine sandpaper to give a smoother finish, and finally all dust should be carefully removed. Emery cloth should on no account be used in the operation, tor the particles, which are conductors, are liable to lodge themselves either in the carbon or between the ligaments in such manner that it is almost impossible to remove them, so that cutting of the commutator or short circuits between the ligaments are likely to ensue.

It is very important that the pressure of the brushes should be carefully adjusted, and by means of a small spring balance this can be accurately performed. It will be found in practice that a pressure of 4 lbs. per square inch will generally give satisfactory results. If the pressure is too great, there will be needless wear both of brushes and commutator, and also undue heating. If too light, sparking will, of course, result. An effort is being made on modern machines to design the brush gear in such manner, that without special precaution being observed, the brushes may be readily set and maintained at the correct position. This object has been more nearly accomplished where the holding device allows the face of the brush to bear straight on the commutator and not at an angle, and the device has a further obvious advantage, when a machine has to reverse its direction of motion.

In many of the older machines, and in some modern machines, where the brushes bear at an angle, special care should be exercised to set and maintain them at the proper position, for if we look upon the diametrically opposite bars of a commutator as the ends of a circuit that is closed by the brushes, it can be readily foreseen where the current would arc, if even one brush were out of its true position. It is also necessary, in order to obtain sparkless commutation with a dynamo or motor, that the brushes be set at the neutral point on the commutator : at the point where the armature conductors are moving parallel to the lines of force set up by the field magnets, and where consequently, there is no generation of current. On most machines this point is clearly indicated, and the position of the brushes has not to be changed with a variation in load. On some machines, however, the point can only be determined by moving the rocker until a position is found where sparking ceases. It may also be necessary to change that position with any variation in load. Thus, in the case of a dynamo, it may be necessary to move the brushes in the direction of rotation of the armature with an increasing load, and in the opposite direction with a decreasing load. With a motor, the procedure is reversed.

Commutator Troubles.

Provided, first, that the brushes are set properly ; second, that the precautions as to cleanliness have been observed ; third, that the commutator is perfectly smooth, that there are no high or low bars, or high or low mica; fourth, if the machine has not become in anyway overloaded, which trouble will reveal itself in abnormal heating of the armature, it may be concluded that any other trouble arising is due to a fault in the armature or fields, and as special facilities are, as a rule, necessary to localize it, we will not, meantime, go into the matter. A careful examination, however, is often all that is necessary to reveal the cause. It will sometimes happen that the ligaments of a commutator will wear down unevenly, owing to the fact that the copper is not all of the same degree of hardness. If this trouble developes, the armature should be removed, and the commutator turned down in a lathe.

A more frequent and also a more troublesome state of affairs is a condition of commutator caused by high mica. Mica best answers all requirements for the insulation of a commutator, and is almost entirely used, but makers find difficulty in securing a uniform degree of hardness. Consequently we sometimes find that the mica projects from the commutator surface. This projection may be so slight that it cannot be felt by the finger, but may be readily appreciated by resting the point of a knife on the revolving commutator, while the other end rests lightly on the fingers

Now, it is of the utmost importance, especially with high speed machines, to have the commutator absolutely smooth, otherwise the brush will break contact for an instant in passing a high plant, and cause more or less sparking. Turning down the commutator in this case will do no permanent good, as the trou-

ble would soon start again to develop. It is claimed that slightly grooving out the mica between the bars is both a preventative and a cure, and further, that the centrifugal force will effectually prevent any particles from lodging in the groove. Should resort be made to this plan, no vaseline or lubricant of any kind should be used on the commutator, while under any conditions, they should only be applied sparingly.

TWO-CYCLE ENGINES*

By R. W. A. Brewer, M.I.Mech.E.

THE author referred to the early work of Mr. Dugald Clerk upon the two-cycle engine, and drew attention to the system of subdividing the charging side of the engine into two separate portions—an air pump and a fuel pump.

Touching on the advantages of the two-cycle engine over the four-cycle, he stated that these were more theoretical than actual as regards power development for size of engine, but the absence of exhaust valves on the former was a very substantial point in its favor.

Coming next to the modern development, he pointed out the disadvantages of two-cycle engines in regard to:—

1.—Crankcase compression.

2.—Having the inlet close to the exhaust and a reversed flow of gases.

3.—Closing of the exhaust port after closing that of the inlet.

He next discussed their advantages, which are:—

1.—Positive pump charging.

2.—Inlet well removed from exhaust, and un-directional flow.

3.—Separation of air charging and scavenging from fuel admission.

He then described some of the more modern engines, including the engines of B. T. Hamilton, Lamplough (Rotary) and Micklewood, also those of Lucas and Mort.

In considering the thermal efficiency of the two- and four-cycle engines the author pointed out that there was very little difference between the two types, but the carburation in the former presented many difficulties, it being found in practice that excessive precipitation of fuel sometimes took place in the pump cylinders, thus accounting for loss on the admission side.

Considering the figures obtained by Dr. Watson in his exhaust gas analysis, he showed that these depended on the assumption that carburation was complete when the exhaust valve opened. This he considered very doubtful, especially in view of the fact that free oxygen up to 5 per cent. volume had been shown in the tests on four-cycle engines, whilst conditions for complete combustion were worse in a two-cycle engine. He then gave figures for tests carried out by himself on a two-cycle engine, in which he allowed 2 per cent. free oxygen as due to incomplete carburation, the remainder being considered as a measure of direct loss of charge down the exhaust pipe. Comparative figures were given in which this allowance was not made.

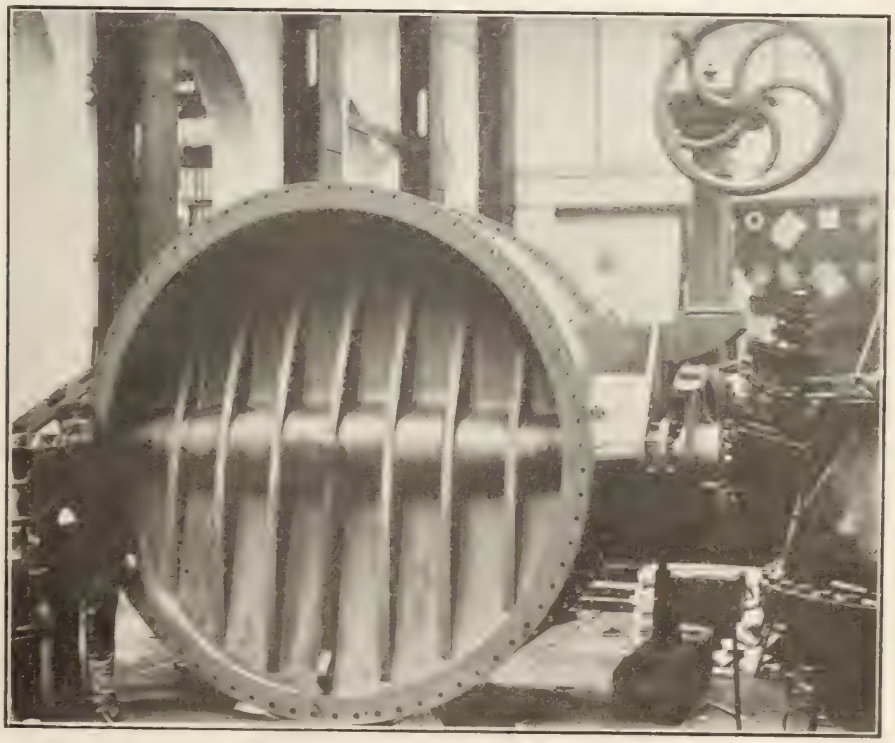
The author described in detail the tests carried out on a Lamplough two-cycle engine, showing the effects of the various adjustments and alterations made as the tests proceeded, and the very interesting results obtained. Analyses of the exhaust gases and deductions therefrom were also given. In conclusion, he referred to the great possibilities of this type of engine, but admitted that very much remained to be done before it could hope to displace the four-cycle engine.

*Abstract of paper read before The Society of Engineers (Incorp.), London, England, November, 1911.

LARGE HAND GEAR OPERATED THROTTLE VALVE.

The accompanying illustration shows an 8 ft. diameter, hand-operated throttle valve with worm gear head stock. It was installed in the penstock of a 5,000 h.p. Morgan-Smith turbine working under 110 ft. head, at the new power house which is to supply the Porcupine district with light and power. The completed valve weighs 10½ tons, its working pressure is 48 lbs. per square inch, and it was tested to double that amount. The photograph shows it enclosed in a section of pipe.

Glenfield & Kennedy, hydraulic engineers, Kilmarnock, Scotland, built the valve, their Canadian representative, John T. Farmer, consulting engineer, Coristine Building, Montreal, being instrumental in securing the order.



8-ft. Dia. Hand Operated Throttle Valve, with Worm Gear Headstock. Makers, Glenfield & Kennedy Kilmarnock, Scotland.

TESTING CAR FENDERS.

Before the Public Utility Commissioners and their engineer, P. W. St. George, tests have been made on the Montreal Street Railway of four car fenders—the Conway, Moorhouse, Rose, and Bray. An unofficial test has also been made of the Hudson-Bowring wheel guard and fender, which is now fitted to the cars. The experiments were very severe, a special car being placed at the disposal of the inventors. Dummies made-up to represent various types of men, women and children, were placed in positions on the line, and the car, fitted with the fender, run first at half speed, then at a speed of 16 miles an hour. In many instances the dummies, instead of being caught, were cut to pieces by the wheels. Mr. St. George will furnish a report of the tests to the commissioners.

November fire losses in Canada totalled $1,506,500. This compared with $580,750 in October and $1,943,708 in November last year. Fires doing less than $10,000 damage accounted for only $88,000 of the total.

REFRIGERATION DEPARTMENT

COLD STORAGE PLANT AT WINNIPEG.

NEW cold storage premises have recently been erected at Winnipeg for the Winnipeg Fish Co. As the plant and equipment are thoroughly modern, a description of the building and machinery will probably be of interest to readers of Power House.

It is of course impossible to carry on a successful fish business on a large scale, without some form of refrigeration. Until recently this company has been conducting the cold storage side of its business without the aid of mechanical refrigeration, and the low temperatures necessary for handling and storing fish, poultry, etc., have been maintained by means of a freezing mixture of ice and salt.

While it is quite possible to do some very satisfactory work in this way, for a great deal of fish is still frozen and stored by means of ice and salt, the Winnipeg Fish Co., decided, in order to keep pace with the requirements of its rapidly increasing business, to erect a new building, and installed a thoroughly, modern and up-to-date system of refrigeration, insulation, and the various appliances for handling, and storing fish, poultry, etc.

The building which is erected at the corner of Sutherland and King Sts. is 66x65 feet, and consists of basement and four stories above. The machinery consisting of the refrigerating plant, air compressor in connection with the water supply from a deep well, and the driving motors are contained in a separate building, outside, but adjacent to the cold stores.

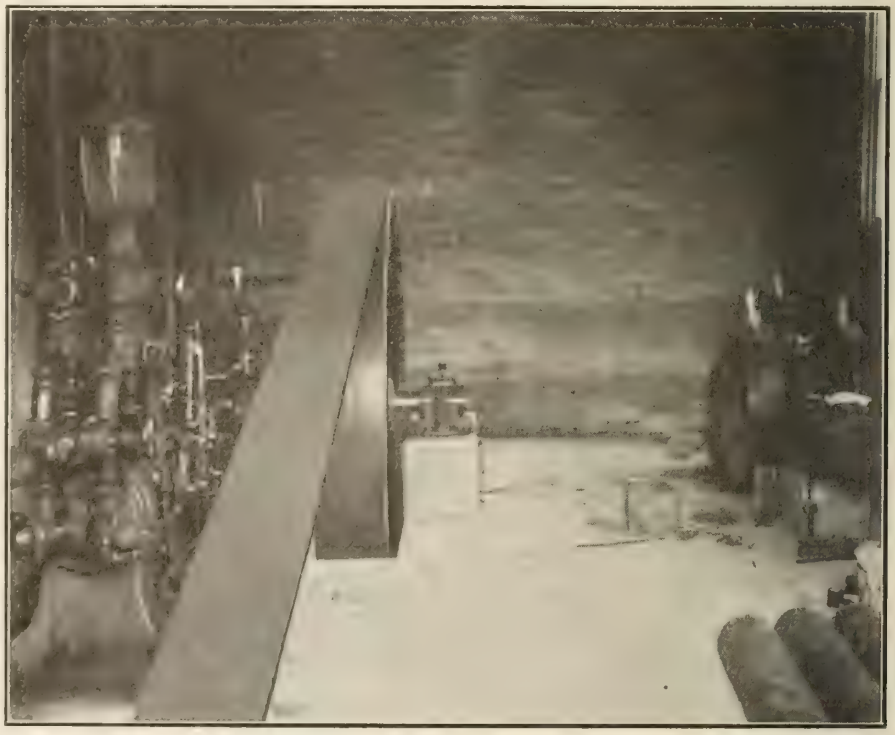
Refrigerating Machinery.

The refrigerating machinery consists of a twenty-ton horizontal double-acting compressor manufacturered by the Vilter Manufacturing Co., of Milwaukee, Wis. The ammonia cylinder is made of a semi-steel casting, turned and rough bored, then pressed into the cylinder jacket by hydraulic pressure, the space between the cylinder jacket and the cylinder proper forming the water jacket. The compressor heads are also semi-steel castings, the inside of the head being turned to a true semi-sphere, thus admitting of a large valve area. The valve chambers are bored on an angle with the centre of the sphere heads. These valve chambers are so fitted that the valves properly rest in the ports so that the valve seats form a part of the sphere, admitting of no clearance between the valve seat and cylinder. The frame is very massive and strong having longitudinal and transverse ribs extending the entire length.

The centre line of compressor is kept as low as possible in order that the vibrations may be absorbed by the base, and the weight distributed over a large area. The entire frame with cylinder jacket, slides and pillow block, is cast in one piece, and the cylinder jacket and slides are bored at one setting, thereby insuring accurate alignment. The crank shaft is made of best hammered wrought iron, on to which the crank is drawn by hydraulic pressure, and keyed in position.

The valves being one of the most important parts of an ammonia compression plant are constructed as follows:— The seats are made of cast steel, the stem and stem-nuts of soft steel, hammered and forged from solid billets in order to make them homogeneous. The body of the valve, and cushion cap, are made of cast iron. The suction valve is specially fitted with a safety attachment to prevent a stem or disc being broken, and dropped into the cylinder. Both suction and discharge valves are conveniently placed in the compressor heads, permitting of easy access for inspection or repair, an important factor in case of emergencies.

The piston is made in the shape of an elongated sphere thus allowing it to travel so close to the compressor heads, that the clearance is reduced to a minimum, it also allows a very large valve area in the compressor heads on account of their shape.



Cold Storage Plant—The Winnipeg Fish Co.

The stuffing box is specially constructed in order to take care of the extremely searching and penetrating character of ammonia gas. All refrigerating engineers know that ammonia gas necessitates particularly right joints, and calls for something superior to steam or air joints. In the engine room of the Winnipeg Fish Co.'s plant not the slightest smell of ammonia can be detected, even when the packing is so loose that the gland collars can be turned with the fingers.

The ammonia compressor is belt-driven, the motive power being furnished by

a 40 h.p. electric motor supplied by the Westinghouse Co. The building is refrigerated by means of direct expansion pipes placed in the various rooms. The Sharp freezers for fish are heavily piped, in order to obtain the low temperature necessary for freezing and hardening up rapidly any fish arriving at the works in an unfrozen state. The quantity of direct expansion piping in the various storage rooms is of course less than in the case of the Sharp freezers, and the proportion of piping to cubic feet of space, varies in accordance with the temperatures required but the amount installed, has been figured liberally, and the quantity is amply sufficient to maintain the various temperatures required in the business.

Water Supply.

The water supply for the entire plant is secured from an eight inch drilled well, 250 feet deep. The pumping of the water from the well is accomplished by the Twentieth Century Air Lift system, furnished by the Canadian Rand Co., Ltd., of Winnipeg. The nominal capacity of the plant is 100 United States gallons per minute.

The plant comprises Twentieth Century air lift pump 8x8 class N.E.—1 Rand air compressor, the air compressor being driven by a 15 h.p., 220 volts, 3-phase, 60-cycle, 850 r.p.m. alternating current, induction type motor.

The entire water supply is first delivered direct to the ammonia condenser, so as to take the fullest possible advantage of the low temperature at which the water comes from the well, which is in the neighborhood of 46 to 48 degrees Fahrenheit.

Elevator Machinery.

The elevator machinery was supplied and erected by the Otis Fensom Elevator Co., and consists of an electric freight elevator with a capacity of 3,000 lbs., and a speed of 50 ft. per minute. The elevator runs from the basement to the roof, and communicates with each floor of the building, as well as the houses erected on the flat roof, where certain operations of the business are conducted. The elevator, therefore, connects with six working floors. It is contained within a brick shaft, and is shut off at each floor by fire-proof shutters.

The Building.

The building itself is constructed with exterior walls of brick, the floors and roof being of mill-construction. Next to a building of reinforced concrete, a properly designed mill-construction building is probably the most satisfactory, from a cold storage point of view. This form of construction stands up well against the exceptionally trying conditions always formed in cold storage work. The fire risk is reduced to a minimum, the insurance rates often approaching closely those obtained on buildings of fire-proof construction. Many so-called mill-construction buildings fail to meet the requirements of the fire underwriters, and the terms "slow burning or mill construction" are often very loosely used. Mill-construction consists in disposing the timbers in solid masses, and avoiding scantlings of small dimensions, the object being to expose the least number of corners or angles to fire. Heavy posts, beams and girders, will not burn through readily. Fire will char the out side of timbers to a slight depth, but the coating of charcoal formed protects the column or girder from destruction. A 12x12 inch wooden post is very much safer in a fire than a steel column, and will stand up better against fire and water, unless the steel is thoroughly protected by fire-proofing material. Another very important point in mill-construction is to cut off vertically every floor from every other floor. In the case of the Winnipeg Fish Co.'s building, these points have received careful consideration.

The floors are of solid timber 6 inches thick carried on girders spaced 12 feet 6 inches on centres. No post or beam has a less sectional area than 100 square inches. There are no openings whatever between floors except for the elevators and stairways, and these are contained within brick shafts, the openings being protected at each floor by fire-proof doors or shutters. The floors are designed to carry a live load of 300 lbs. per sup. foot. The insulation of the cold rooms is a combination of cork board and lith, the cork board being employed in positions where the greatest moisture will be found. In all cases the insulation is of solid form, concealed spaces being avoided. The insulation is thoroughly water-proof, and is protected with a coating of Portland cement plaster.

These new premises of the Winnipeg Fish Co., form one of the most complete and up-to-date cold storage plants in Canada, and the work has been carried out in record time, having only been commenced at the end of July. The building was designed by E. J. Greenstreet, F.R.A.I.C., cold storage architect of Toronto.

CITY OF SOREL, P. Q.

The City of Sorel, Que., 50 miles from Montreal on the south shore of the St. Lawrence, is undergoing considerable expansion and development. In addition, steps are being taken to locate manufacturing plants there, and with this end in view, the City Council is offering exceptional privileges. The water transportation facilities are probably unequalled in Eastern Canada, the city not only being on the direct routes to Europe via the River St. Lawrence, and to the Great Lakes via Lake Champlain, but possessing as well a harbor capable of accommodating ocean-going vessels. There is abundance of cheap labor and electric power, and the council, having retained several good factory sites, are prepared to grant liberal concession. It is confidently expected that as a result of the present movement, Sorel will become one of the leading manufacturing centres in the Province of Quebec.

STEFFENS & NOLLE OPEN CANADIAN BRANCH.

Among the firms who have recently entered the Canadian markets is the large German house of Steffens & Nolle, Ltd. The head office and factory are in Berlin, Germany, where they have over a thousand employes. The firm is capitalized at $2,250,000, and their Canadian headquarters is Room 27, Beardmore Building, Montreal. They are carrying a full line of hardware, wood and metal-working machine tools, and will also handle heavy iron goods, including structural steel, sheet metal, seamless drawn tube, steel sheeting, forgings and castings. Mr. W. Steffens is manager of the Canadian branch, and Mr. R. W. Bartram, for some years purchasing agent for the Allis, Chalmers, Bullock Co., is prominently connected with the firm.

NEW GAS POWER PLANT AT CAMPBELLTOWN, N.B.

The Town of Campbelltown, N.B., where, on July 12th, 1910, there was nothing but a bare expanse of smoking ruin, will shortly have reason to congratulate itself on having one of the most up-to-date gas power plants in Canada. This, when completed, will comprise a 4-cylinder 350 h.p. gas engine, driving a 250 k.w. generator, and a 2-cylinder 175 h.p. gas engine driving a 125 k.w. generator. The 2-cylinder engine is already running and the foundations are in place for the larger engine. Both engines will operate on suction gas, and the whole apparatus is being supplied by the Canada Foundry Co., Toronto.

Since the fire, the town has been using a temporary steam engine outfit, and we understand the consumption of coal has been about 7 lbs. per h.p. per hour. With the gas engine and gas producer equipment, equal output is being obtained with one pound of coal per h.p. per hour. Light is being sold at 10 cents per k.w. hour, as compared with 15 cents in St. John, N.B. The maximum charge for power will be $20 per h.p. per year.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

INTERNAL COMBUSTION ENGINES.

By A. F. White, Toronto.

THE explanation of the cycle, also the fuels used in internal combustion motors having already been discussed in two previous issues, the object of this article will be to describe some of the construction principles of a gas engine.

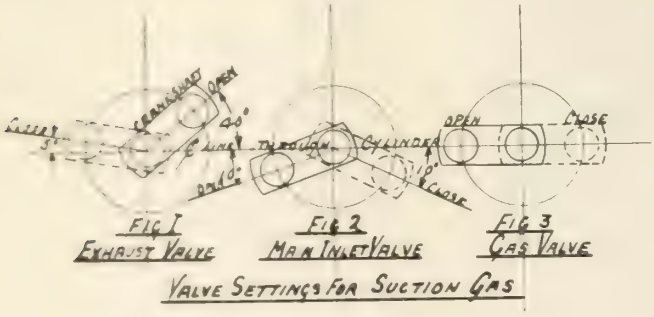
Types of Engine.

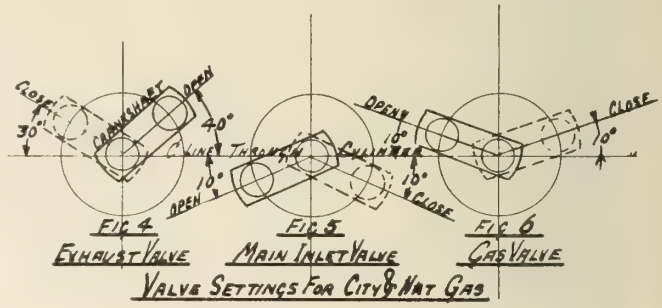
The single cylinder horizontal design offers the simplest form of gas engine, and makers are now constructing this type in sizes capable of developing as high as 200 h.p. in one cylinder. The usual practice, however, is to duplicate from 100 h.p. per cylinder or thereabouts, and in order to obtain higher powers, 3 or 4 cylinders are used. This layout gives that more even turning movement so essential for electric lighting. The high speed vertical engine finds much favor in cases where floor space is restricted. Again it is more suitable and is used almost exclusively for automobile and marine work. Practically all moderate sized Otto cycle engines are single acting, and have a long trunk piston which acts as a crosshead, and at the same time permits the use of several packing rings by which the leakage past the piston is prevented, even at the high pressure obtained by the explosion. This latter may be from 350 to 400 pounds per sq. in. at the commencement of the power stroke.

Valves and Valve Setting.

Since the Otto cycle occupies two revolutions, the valves and igniters have to operate once in that period, therefore, the cams which drive them are mounted on a shaft running only half as fast as the main crankshaft. This is accomplished on different engines by spur, [illegible] and spiral gears.

There are three valves required when [illegible] and known as gas, main inlet, and exhaust valves. They are nearly always of the poppett or mushroom type. To carry out the functions of the various strokes made by the piston of an engine working on the 4 cycle principle, it is necessary to arrange the opening and closing of the different valves at the correct points of the stroke. This is accomplished by properly shaping the cams which lift them, and fixing their relative position upon the half speed shaft. It may sometimes be necessary to check these over, especially if the engine has been dismantled or overhauled, in which case figs. 1 to 6 may be found useful. The variation in valve setting for suction, city or natural gas will be noted by comparing figs 1, 2, 3 with 4, 5, 6, the chief difference being apparent in the setting of fig. 6, which opens later and closes earlier when operating with city or natural gas than when working on suction gas, fig. 3. The exhaust valve, too, is usually made to close a little earlier with suction gas. The setting, figs. 4 and 5, may be used for a gasolene engine.





Ignition and Explosion.

Ignition is usually made adjustable, so that it may be varied to suit the fuel and retarded for starting purposes; the usual range being from about dead centre of crank to 45 degrees early. When the engine is working, it is best to advance the ignition to a point at which the engine commences to knock a little on the firing point, and then retard slightly until the knock is hardly noticeable.

The explosive mixture in the cylinder consists of air united with a quantity of gas, the amount of the latter being determined by its calorific or heat value. Good city gas has a heat value of about 700 B.T.U. per cubic foot, while the heat value of producer gas is only about 130 B.T.U. per cubic foot. Natural gas heat value varies considerably in different districts and is sometimes as high as 1000 B.T.U. per cubic foot. When city gas is used, the mixture will average about 7 or 8 parts of air to one of gas, and with producer gas about 1.2 parts of air to one of gas. For this reason, it is apparent that the pipes and valves have to be much larger for producer gas than for either city or natural gas.

In order to obtain the best results in a gas engine, both with regard to the maximum explosive force and also economy, it is necessary to regulate carefully the gas and air supply, so that the correct mixture be taken into the cylinder for perfect combustion. No direct rule can be given for this, but the best results are usually obtained, when, with the maximum amount of air admitted per charge, a very slight knock is heard on the crank at the time of the explosion. The explosive mixture, after being taken into the cylinder during the suction stroke, has to be compressed on the compression stroke until it finally occupies only the clearance space between the piston and combustion chamber; the piston being at its inward dead centre and firing point. The amount of clearance and compression varies considerably. With different fuels in kerosene and gasolene engines, other than the Diesel type, the compression is usually from 65 to 75 pounds per sq. in. For city and natural gas, about 100 pounds per sq. in. gives excellent results, while with producer gas, as high as 150 pounds per sq. in., is generally adopted.

Water Jacket.

A water jacket, or equivalent device has to be provided to cool the cylinder, as, without it, the engine would become inoperative, because the high cylinder temperature produced by the explosions would not only vaporize the lubricating oil and cause rapid destruction of the bore, but result in the entering mixture

being exploded before its time through contact with the hot metal. On large engines it is necessary to water jacket the exhaust valves and piston as well. The usual arrangement for small sized engines consists of a water tank of considerable capacity connected at its bottom to the lower part of the engine jacket, and near the top, to the upper part. The water in the jacket, being heated, rises and flows to the top of the tank and the cold water from the bottom of the tank takes its place. The most efficient working jacket temperature is about 150 degs. F.

ELEVATOR PROBLEM.

By S. Balmfirth, Montreal.

MR. O. P. St. John's elevator problem in the October issue of The Power House, seems at first sight a very tricky one, but close investigation reveals the fact that one feature is missing: I refer to the element of time; for, in calculating work done, elapsed time must always be included in the reckoning.

If we assume a weight of one ton, in addition to the 500 pounds unbalanced weight of the car to be the full load for the elevator, and the time one minute, the work done, neglecting friction, will equal $(2000 + 500) \times 100 \times 1 = 250{,}000$ ft. lbs.

Again, assuming a ratio of 10 to 1 between car travel and piston travel, and also a piston area of 1 sq. ft., we get a mean effective pressure of:

$$\frac{250{,}000}{144 \times 10} = 173.61 \text{ pounds per sq. inch.}$$

Now, if only the empty car is to be raised, the work done will be:
$500 \times 100 = 500{,}000$ ft. lbs., and if the throttle, or control valve be opened wide, the time occupied to make the trip will be:

$$\frac{50{,}000}{10 \times 144 \times 173.61} = .2 \text{ minutes or } 12 \text{ seconds.}$$

In both cases, a like amount of water at the same pressure has been used, and there has been no lost energy. If, however, the same time is taken for the up trip with both loads, the equation for the empty car will be:

$$\text{Pressure} = \frac{500 \times 100}{10 \times 144} = 34.79 \text{ lbs.}$$

In this case, we have a pressure of 175 lbs. (approx.) on the accumulator side of the control valve, and about 35 lbs. on the elevator side. While a like quantity of water has been used, at the same pressure, there has been a large amount of energy lost by throttling the supply to the elevator, and just how much may be gathered from the following:

$(173.61 - 34.79) \times 10 \times 144 = 199{,}900$ ft. lbs. The difference between this figure and 250,000—50,000 is due to the decimals. Expert B. is quite right when he says, that in mechanics, it is impossible to get something for nothing.

If the elevator were operated by means of compressed air directly, the case would be entirely different. Thus, for liftng a ton weght, the product of volume and pressure in the accumulator would be:
$500 \times 173.61 = 86805$. The amount of air used by the elevator would be:
10 cub. ft. $\times$ 173.61 lbs. $=$ 1736.1, and the resultant pressure of the air left in the accumulator would be:

$$\frac{86805 - 1736.1}{500} = 170.137 \text{ lbs.}$$

In the case of lifting the empty car, the resultant pressure of air in the accumulator would be:

$$\frac{86.805 - (34.79 \times 10)}{500} = 172.95 \text{ lbs.}$$

These figures do not allow for friction or loss of pressure through valves and piping.

REFRIGERATION AND BRINE.

By W. G. Walters, Stratford.

BEFORE we can properly appreciate the value of refrigeration as a contributory factor to man's welfare, it is necessary to form a clear conception of the causes which bring about decomposition and waste. All decaying substances when examined under the microscope are seen to be swarming with micro-organisms, although invisible to the naked eye. Like all living things, these micro-organisms bring about the chemical transformation of matter by feeding on substances in one form and excreting them in another; or else by producing ferments which bring about these changes. Now these spores or seeds, so extremely minute, float in the air and are continually settling like dust on every object, whose conditions and surroundings are favorable and suitable. On obtaining a foothold they quickly breed and multiply.

The conditions may be classed under four heads:—(1) Suitable food; (2) Presence of moisture; (3) Suitable temperature; (4) Absence of substances which either kill or prevent them developing. Animal matter intended for human consumption provides suitable food for micro-organisms, but it is essential for their development that moisture should be present. In mechanical refrigeration we have a sure method of destroying these micro-organisms, and in the cold air system, where a suitable brine is used in conjunction with air ducts and fans, we have the most efficient and sanitary means of protecting foodstuffs known at the present day.

In discussing this question of refrigeration from a sanitary standpoint, it may be well for us to have some knowledge at least of the systems of refrigeration now in use. Different chemicals are employed in mechanical refrigeration, but in this article I will only deal with that of liquid anhydrous ammonia. In the employment of ammonia, there are several arrangements. We have what is called the direct expansion system where the ammonia is expanded directly into coils of piping situated in the room that is desired to be kept cool. Again, we have the coils placed in a tank of brine, and the brine after being cooled by the ammonia expanding in the coils is carried by a pump to the desired location, and allowed to circulate through another series of pipe coils before being sent back to the ammonia coils to be recooled. We have also what is known as the dry air system. In this the ammonia expands in a set of coils placed in the brine tank. The brine is circulated over and among the ammonia coils, and fans are employed to drive air from the coils through ducts to the rooms that want cooling. This last is superior to all other known methods employed in refrigeration for destroying micro-organisms and protecting foodstuffs intended for human consumption. Its value, however, as a medium of refrigeration and also as a protector against micro-organisms, depends to a large extent on the ingredients employed in producing the brine. The air circulated through the different rooms is constantly being used for recooling, and in passing over and through this brine it is washed and its impurities removed.

Brine is a solution of either common salt (chloride of sodium) chloride of calcium or chloride of magnesium in water. Brine made of chloride of magnesium is undesirable, being liable to contain free acid, injurious to metals. Common salt or the commercial fused chloride of calcium are both free from acid. Salt is usually sold per bag containing about 200 lbs., and costs about $7 per ton. Commercial fused chloride of calcium is sold in iron drums holding about 600 lbs. each, and costs about $16 per ton. The purest and best salt only should be used, and salt for brine making should not contain more than 0.05 per cent. of insoluble matter. If the percentage of insoluble matter is bulk, it will accumulate and be liable to cause trouble in the circulating pipes. The use of chloride of calcium does not obviate the inconvenience liable to be caused by the presence of insoluble matter, but for temperatures below -7 degs. F., it is ab-

solutely necessary that it be used, for the reason, that whereas a solution of common salt can only be cooled to -7 degs. F., a solution of chloride of calcium can be cooled to 40 degs. F. To explain the way in which the strength affects the freezing point of the solution, a brine made of common salt will be considered. If a weak solution of common salt in water is gradually cooled, ice will begin to separate out at about 28 degs. F., and this separation of ice with a proportional concentration of brine, will continue till the temperature of -7.5 degs. F. is reached. At this point, the brine will contain 24.24 per cent. of salt, and if further cooled will become solid. On the other hand if a saturated solution (at 60 degs. F.) of salt is cooled, the latter will separate out, and the brine will weaken until the same temperature and degree of concentration is reached as in the other case, and the solution will become wholly solidified.

For all ordinary purposes, such as ice manufacture, [illegible] purpose where it is highly improbable that a temperature below -7.F. will be needed, brine made from common salt may be used, but in warehouses where a low degree of temperature is a necessity or when the foodstuffs are of a moist nature, chloride of calcium is the most suitable. Although the first cost of brine made from chloride of calcium is much greater it has its redeeming features. A much lower temperature can be carried with a chloride calcium brine than with a salt brine. Salt brine is very corrosive, attacking the ammonia coils and tanks, while the chloride of calcium brine is non-corrosive. Another valuable feature of chloride of calcium is its moisture attracting qualities, as it will absorb moisture from anything within reach of its influence and has a destroying effect on all micro-organisms.

ELEVATOR PROBLEM

By W. A. Worell, Barbados.

Concerning the "Elevator Problem" in your issue of October, 1911, expert B. is right. The additional energy is spent as time:—The empty car will rise through 100 feet in less time than when loaded. We know that a horse power in mechanics means a given amount of work done in a given time, therefore, the water that flows through the orifice of the admission valve will do so at a speed in accordance with the increase of load. It is clear that if water runs through an orifice with a pressure of 100 pounds to the square inch behind it, and it has to meet a pressure, of say, 10 pounds per square inch, the quantity that passes the orifice in a given time will be less if the resistance pressure be increased to 50 pounds per square inch. As it calls for a certain quantity of water to fill the cylinder, the loaded car must take longer to rise 100 feet.

STATIONARY ENGINEERS' EXAMINATIONS.

Eighty-three stationary engineers of St. John, New Brunswick, have passed through the ordeal of examination for licenses and will receive their certificates at an early date. J. Alchorn and John Smith, with Factory Inspector Kenny, as secretary, formed the examining board. Several applications were received which were not considered as the applicants did not put in an appearance. The board is to sit next at Fredericton. Different parts of the province must be visited before the new year opens, according to the law, but the examiners will return to St. John early in January when further applicants may come before the board.

THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

By Generator.

YOUR editorial in the November issue on the C.A.S.E., "What it has attained and its possibilities," is certainly to be commended, and if you would hand out a liberal supply of the same kind of dope in subsequent numbers, I am sure it would have a beneficial effect. It is a regrettable fact that the C.A.S.E. is not fulfilling the anticipations of those who have been induced to become members. It is all very well to invite all operating engineers to support and become members of the organization, but unless we can demonstrate to a man that he is going to derive some material benefit by so doing, other persuasion will not have much effect. Again, if a prospective member is from Missouri and begins to question us concerning the accomplishments of the order, we are at a loss to answer him.

Now, what is the disease afflicting this association. Let us try to diagnose it, and if we succeed, perhaps a cure may be effected. In my humble opinion, the majority of the members of the order are in favor of increased legislation along the lines of license law, graded certificates, and compulsory boiler inspection. In fact, we may claim that all stationary engineers, both in this order and out of it, are in favor of increased legislation, but in the case of the C.A.S.E., the executive officers are expected to take the initiative. What do we find? At the annual convention, we have a good time, talk big for two or three days and forget all about it until convention time arrives again. Is this not where the fault lies? Are the executive officers of the C.A.S.E. doing their full duty by the organization? I claim that they are not. They have no vital interest in the operating engineer's affairs. for the fact remains that a majority of the present and preceding executive officers are not operating engineers.

I have always maintained that a man whose salary did not depend on his license will not take the same interest in the problems of the stationary engineers as one whose livelihood has to be gained by operating. There is no lack, in the ranks of operating engineers, of efficient men with the ability and interest in their profession to make capable executive officers, and who would work for the advancement of the profession. About all our present executive are interested in, is the "honor" attached to their positions. I bear no animosity, and recognize them as good fellows, but, the fact remains that there is too much sentiment displayed in the selection of officers for the C.A.S.E.

The lack of organization has been repeatedly brought home to us in our efforts to secure legislation. We have been told to agree on what we want, make proper application, and the legislature will grant our requests.

There is one section of our profession which should be actively engaged in the work of agitating for the enactment of boiler inspection, engineers' license laws and the enforcement of those already existing. This is composed of stationary engineers belonging not only to the C.A.S.E., but to every other recognized organization. Their interests are mutual, and if increased remuneration and better working conditions result from any enactment, so much the better, although, perhaps these should come as a sort of by-product and not as a first consideration.

In the preamble and constitution of the C.A.S.E., we have a sure lever to gain the support of power plant owners, for they can readily see that it is to their advantage to have their power house employes educated along the line of his daily work, and the majority of manufacturers, if assured that the big stick would not be held over them, would gladly assist in strengthening the license law. This, then, is the opportunity. Let us elect men to our executive, who, we know, will work for our advancement, and having done so, give them our undivided support. In doing this, we may possibly justify the existence of the Canadian Association of Stationary Engineers.

FORCE, WORK AND POWER.

By Chas. J. Mason.

THE terms, force, work and power, which we hear used so often, and see so frequently in print, bear a relation to one another that is not always clearly understood. The subject is old, and what I am about to say concerning the relation between the terms in question, will not be "fresh news" to all who may read. We must not forget, however that the growing ranks of steam engineers contain many of the rising generation who have not yet learned the difference and the relation that exists between the terms, Force, Work and Power. It is for them, therefore, the young fellows, that I venture the following:

Definition of the Terms.

First, as to the definition of each term:—Force is any cause which changes or tends to change the condition of rest or motion of a body. Work is the product of a force, by the distance through which it moves or acts, and is measured in foot-pounds. Thus, pounds-force is multiplied by feet space, through which the force acts. Power is the rate at which work is done. In power, the element of time enters, and time must enter into all calculations in which power is involved. Work done is independent of time, but power developed, delivered or consumed in performance, must include it. Raising 33,000 pounds through a height of 1 ft. in 1 min. of time is considered equivalent to 1 h.p. Again 33,000 lbs. raised 1 ft, or 1 lb. raised 33,000 ft., would be 33,000 ft. lbs. of work, whether accomplished in one minute or one month.

In order to illustrate and give a practical application of what has just been said, let us take an ordinary pump such as every operating engineer is familiar with. Let us assume that the water piston has an area of 100 square inches. Further, that the pressure acting against the piston is 50 lbs. per sq. in. The force against which the piston is moving is $100 \times 50 = 5{,}000$ lbs. total. The work done by the pump per stroke is as follows:—24-in. stroke; 100 sq. in. area of piston; 1,728 cubic in.=1 cubic ft.; 62.5 lbs. of water=1 cubic ft., therefore, $24 \times 100 \times 62.5 = 86.8$ lbs. of water per stroke. For finding the height to which the water is raised, we have 50 lb. per sq. in. pressure. As 2.3 ft. height =1 lb. pressure per sq. in., therefore, $50 \times 2.3 = 115$ ft., and 86.8 lbs. of water raised through 115 ft.$=86.8 \times 115 = 9982$ ft.-lbs. of work per stroke.

Finally to find the power developed at the water end of the pump, let us assume 50 strokes per minute; then, 9982 ft.-lbs. per stroke multiplied by 50 strokes=499,100 ft.-lbs. per minute. As before stated, the unit h.p. is 33,000 ft. lbs. per minute, therefore,

$$\frac{499{,}100}{33{,}000}$$

15 h.p. developed at the water end of our pump under the assumed conditions.

In actual practice, certain allowances for loss, slippage and friction would have to be made, each of which would affect the result considerably. These have been ignored, because the aim of the article has been to explain simply and illustrate the meaning and application of the terms. To secure the h.p. necessary for service conditions, the aforementioned total of 15 would be multiplied by 100, and divided by the known efficiency per cent. of the type pump.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

Questions and Answers

Q—1 What load can be raised by a block and tackle, having 3 pulleys in the upper and two in the lower or movable sheave? The pull on the free end of the rope is 60 pounds, and the efficiency of the apparatus is 35 per cent.

A—1. On page 321 of the November issue of The Power House will be found a full explanation of the principle involved in this answer. Find the load W that can be raised, by the methods there explained and multiply the answer by 35-100 to compensate by the loss of efficiency.

Q—2. Explain the action of an injector

A—2. At first sight the action of an injector seems to be a paradox, since water is delivered into the boiler against a pressure equal to, or greater than that of the steam operating the injector. The explanation is as follows. The velocity of an issuing jet of steam is many times greater than that of a jet of water issuing under the same pressure and if steam, while issuing from a boiler, be condensed, but not reduced in velocity to that of water issuing under the same pressure, it is then capable of overcoming the pressure of the water in its own boiler. This is exactly what takes place in the injector. The steam on entering, passes through the cones and is condensed on coming into contact with the feed water, without losing its velocity, further than that due to friction in the passages. The vacuum formed by the condensation of the steam causes more water to flow into the injector, and this feed water is carried on by the force of the condensed steam jet into the boiler. The velocity of the steam jet is much reduced by imparting a high velocity to the feed water, but as it is not reduced nearly so low as that of a jet of water issuing under the same pressure, sufficient momentum is imparted to the feed water to lift the boiler check valve.

Q—3. Calculate what horse-power may be safely transmitted by a 16-inch double leather belt running on an engine flywheel 14 feet in diameter, and making 80 revolutions per minute.

A—3. A safe working stress for single leather belting is 45 pounds per inch of width, and for double belting 75 pounds per inch of width. The horse-power transmitted will be the total stress on the driving side of belt multiplied by the velocity of belt in feet per minute and divided by 33,000.

Total stress is $75 \times 16 = 1200$ pounds.

Velocity of belt is $3.1416 \times 14 \times 80 = 3518.6$ feet per minute.

Horse power transmitted is

$$\frac{1200 \times 3518.6}{33{,}000} = 128, \text{ nearly.}$$

Q—4. A water tube boiler has 150 tubes $3\frac{1}{4}$ inches outside diameter by 15 feet long. What is the heating surface in the tubes.

A—4 First calculate the circumference of a tube $3\frac{1}{4}$ inches outside diameter and divide the result by 12 in order to get the answer in feet. Multiply this result by 15 feet length, and we shall get the heating surface of one tube expressed in square feet. The total heating surface of the tubes will be 150 times this amount.

$$\text{Thus } \frac{3.1416 \times 3.25 \times 15 \times 150}{12} = 1914.41$$

Q—5. What is the total pressure on the bottom of a cubical tank 8 feet deep, if it is half filled with water?

A—5. Since the tank is a cube 8 feet deep, the dimensions of the bottom are 8 ft. by 8 ft., and the depth of water being 4 feet, we have a total volume of $8 \times 8 \times 4$ or 256 cubic feet.

One cubic foot of water weighs $62\frac{1}{2}$

pounds, so the total pressure on the bottom of the tank is
256 × 62.5 = 16,000 pounds.

BOILER COMPOUNDS.

THE following abstract from a paper read before the American Society of Naval Engineers, by Lieutenant Commander Frank Lyon, U.S. Navy, should prove valuable to all interested or engaged in the operation of steam boilers. While the tests and conclusions arrived at affected primarily marine boilers, it is at once apparent that to an equal degree stationary steam boilers come under their scope.

"In the summer of 1910 it became a part of the writer's duties to examine, test and report upon some boiler compounds with a view to finding that best suited to naval use. The literature upon the subject being very meager, it became necessary to devise a method of making the tests. The plan adopted and the principles involved are given as follows :

Requirements of a Boiler Compound.

The perfect boiler compound for naval or marine use will be one capable of fulfilling the following chemical requirements :—(a) It must render the water in the boiler non-corrosive at any temperature to which it may be subjected. (b) It must hold in suspension, or preserve in the colloidal form, all of the salts in the water that would otherwise be precipitated as scale, whether such precipitation be by the action of heat or by that of any of the chemicals used in the compound. (c) It must render the treated water no more liable to foam or prime than distilled water would under the same conditions. (d) It must be composed of chemicals that are safe to store, that do not deteriorate materially with age, and that are non-explosive and non-inflammable. In other words, the compound must be such that it requires no particular care in stowage and handling. (e) Some one constituent must be such that its strength in the water (its concentration) can be easily measured by some simple chemical measuring device. In brief :—The compound must render the water in the boiler non-corrosive and non-scale forming ; it must be easy to care for and use, safe for [illegible], and the net effect of its constituents must be such as will not increase the surface tension. The following is the series of tests suggested, to which all such compounds should be subjected : (A) Chemical :—(B) Corrosion :—(C) Scale removal :—(D) Priming.

How to Use the Compound.

A boiler compound, that will show excellent results under the foregoing tests, can be made to work in any boiler, with any water, if the boiler and water are properly treated. Many such compounds are condemned on first trial with boilers in actual use, because they do their work better than expected, and the man in charge of the plant fails to do his part. When contemplating the use of a compound, the man in charge must first understand the nature of the treatment, the results to be obtained, and have the co-operation of the fireman to obtain the latter in desirable measure.

Before putting a new boiler into operation, it should first be well boiled-out for at least 24 hours with a strong solution of the compound, using the surface and bottom blow-off for about two minutes each hour ; feeding with distilled water, if possible, to make up the loss, and adding more compound after each blowing-off. Again before starting the use of compound in an old boiler, the same preliminary details should have attention ; the reasons for their adoption being as follows :—

(1) When starting-up a new battery of boilers, there is always found more or less greasy scale and dirt thrown down, even when good distilled water is used for boiler feed.

(2) In an old boiler which is considered to be as clean as possible, a good compound will cut a very considerable amount of grease and scale from the apparently clean surfaces.

(3) In an old boiler which has not been cleaned, the action of the compound would first be to form colloidal solutions with any scale-forming ingredients that are in the water. The excess of compound then acts on the scale and grease attached to the various surfaces, loosening and throwing them down on to lower surfaces, and in time dissolving these impurities. If the boiler is boiled out, using good water with the compound, much of this scale and grease will be loosened and a great part of it can be removed through the blow off. After boiling and blowing for 24 hours, the fires should be allowed to die out, and before the pressure is entirely gone, all the water should be blown out. The lower manhole and handhole plates should then be taken off and all loose scale raked out. If this is not done the loose scale and greasy solution may do the boiler harm. The boiler should now be closed, pumped full of non-corrosive solution of the compound, and given a hydrostatic test for tightness. If tight, the water should be run down to steaming level, after which it is ready for regular operation.

When fires are started to put the boiler in regular operation the bottom blow-off should be used freely as steam rises. When steam is up to working pressure, the strength of the compound should be measured and brought up to that of a non-corrosive solution, if it is not already there. The saturation should then be taken with the ordinary salinometer pot and hydrometer bulb, its record being considered the base saturation. The strength of the solution and the saturation should be taken daily. The former as drawn from the boiler should be brought up to that of a non-corrosive solution whenever it is found below that strength, and the bottom blow should be used whenever the saturation is found 1.32 above that of the base, as shown by the ordinary marine hydrometer. If this method is carried out for a short period of time the boilers will be cleaned.

By keeping an accurate record of the amount of decrease of strength of solution daily, a fairly accurate deduction can be made as to how much additional compound is needed each day so long as the character of the feed water is not changed. When the constituents of the compound are non-volatile at the maximum temperature to which the boiler water is subjected (as they surely should be) the strength of the compound will remain constant if the feed water is pure and there are no leaks ; if the blow-off is not used, and if the boiler does not prime. The loss of strength is due to the constituents of the compound combining chemically with those of the dissolved scales and in the feed water, with which they re-act ; to the water lost by leaks and blowing-off, to the water carried over in priming, and to the make-up feed being assumed as fresh.

The writer has measured the alkaline strength of the non-corrosive solutions of the compounds, for the reason that all compounds and chemicals with which he has experimented and which stop corrosion entirely, except the chromate solutions, give an alkaline reaction. They require the same amount of 1-10th normal sulphuric acid to make a 50 c.c. sample show an acid reaction with the standard neutrality indicator. In my opinion, the only way to properly deal with the question is to measure the strength of the solution in water drawn from the boiler and treat it in accordance therewith. Any rule of treating water other than by measuring the strength of the solution as drawn from the boiler is dangerous, for the reason that if the character of the feed water changes at any time a different amount of compound will be needed with each character of feed water. The constituents in the compound should be so arranged that among the non-corrosive are included enough of the non-scale forming and non-priming elements to automatically make the perfect compound, in all characters of water when the solution is made non-corrosive. One thing that has been proved, is, that unless a compound be used properly it is better let alone.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

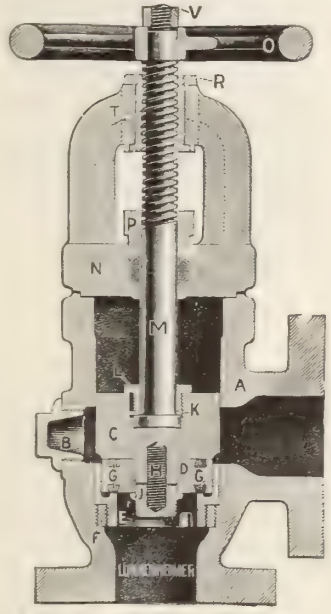
AN IMPROVED BLOW-OFF VALVE.

THE cut herewith fully illustrates an improved design of blow-off valve, which embodies a number of important features highly appreciated by users. Heretofore, in most makes of blow-off valves, the seat was so located that as the disc approached it there would be an accumulation of scale and sediment. The effect of this was to cut the bearing surfaces to such an extent, that in a short time the valve became leaky.

Various methods have been invented, whereby the disc would fit tightly in the valve body, the object being to prevent scale from passing on to the seat bearing, after the disc had passed and cut off the inlet. This method, however, has not proved satisfactory, as the valve soon wears, and in a short time, permits the passage of scale and sediment. These defect appear to have been overcome in this improved design blow-off valve. The plug fits snugly in a separate and easily removable bronze casing, which can be readily replaced when worn. Any accumulation of scale or sediment that might remain on the seat before the disc is brought in contact, is washed by the water which passes around the plug when seating.

Detail Particulars.

In the sectional view, it will be seen that the plug C carries a reversible, double-faced disc D, secured to plug C by stud H and nut J. This plug C is guided perfectly in the valve body A. The bronze seat ring E is screwed into a second brass ring F, the object being to make it possible to renew E easily, in case same is worn. At the back of the valve is a plug B, the use of which is to permit the introduction of a rod to clean out the blow-off pipe when desirable. A hose may also be inserted to wash off the seating surfaces, particularly after the boiler has been cleaned. The stem M, which raises and lowers the disc C, is held in place by lock-nut L, and which is prevented from unscrewing by non-rotating washer K. The threads of the stem N operate within an easily removable bronze bushing in the top of the yoke.



An Improved Blow-off Valve.

It will be noted from this description, that all parts of the valve have been so designed that they can be easily renewed when worn or broken. The disc D has two lead alloy bearings GG. It can be replaced at small cost, or the user of the valve can melt out the old Babbitt, pour in new metal, and after this is faced off, have a disc as good as new. The manufacturers claim that the lead alloy, as usually furnished in the discs, has invariably given perfect satisfaction, but to meet unusual conditions, a harder or softer alloy can be had.

In operating the "Duro' valve, and it is desired to close same, the disc is screwed down in the usual manner. As the edge of disc D approaches the cylindrical extension of S, these edges shear and cut off any scale or sediment which might pass. As the disc D continues to approach the seat bearing E, the leakage of water around same will effectually wash off any scale or sediment which might have accumulated thereon. As a result, when the disc is perfectly seated, no scale or sediment remains between the bearings.

The valve, known by the trade name of "Duro," is constructed of high class materials, carefully tested, and the Lunkenheimer Company, its manufacturers, guarantee efficiency, and durability, under exacting service conditions.

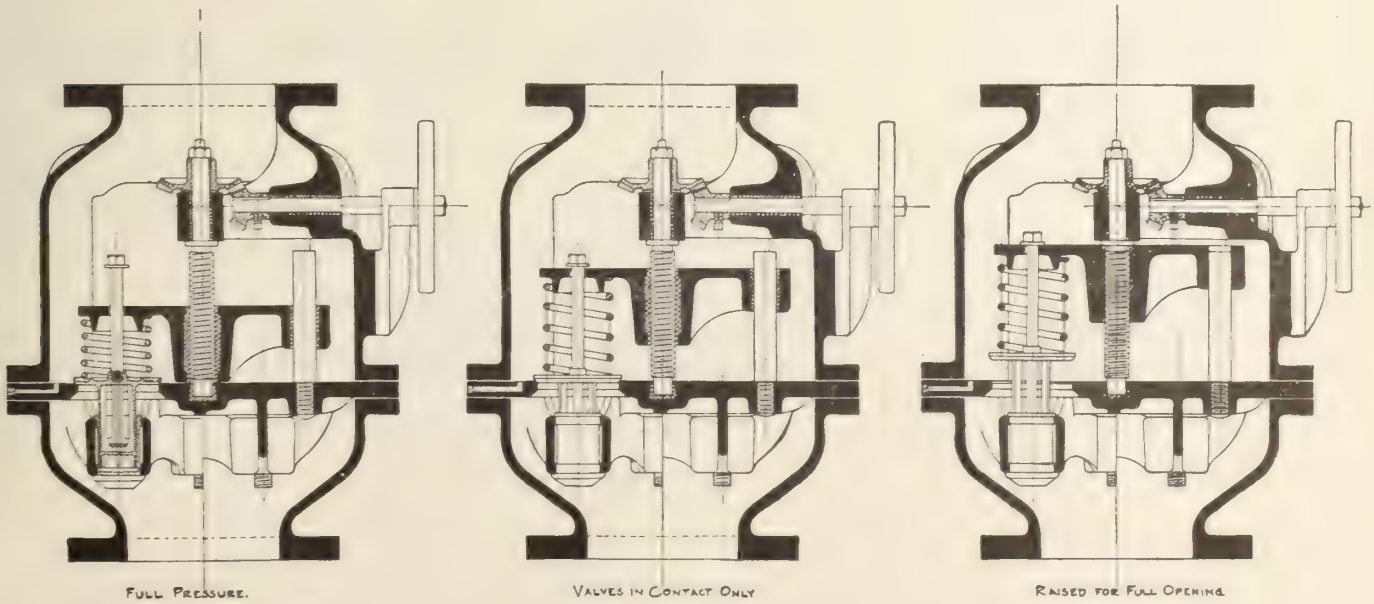


Fig. 1 — Diagrams showing three principal positions of Pressure Plate in Cochrane Multiport Safety Exhaust Outlet Valve

A NEW LINE OF BACK PRESSURE AND ATMOSPHERIC RELIEF VALVES.

BACK pressure or atmospheric relief valves, such as are used to protect exhaust steam heating systems, feed water heaters, absorption ice machines, cooking kettles, and other apparatus, using exhaust steam against dangerous accumulation of pressure, belong to the general class of safety valves differing therefrom principally in that they are designed to discharge steam at low pressures. This difference, however, has an important bearing on the design and proportion, since steam escaping from a safety valve at a pressure of 150 lbs. has a velocity of from 2,000 to 3,000 feet per second, and as the density under these conditions in the smallest cross-section of the orifice corresponds to a pressure about 60 per cent. as great as the initial pressure, a small opening is able to discharge a considerable weight of steam. On the other hand, steam, under a back pressure of 6 lbs escaping to the atmosphere, has a velocity of only 1,000 feet per second or so, so that in order to discharge the same weight in a given time, the area of the valve opening must be about 30 times as great as that of the safety valve. These facts demonstrate the futility of the occasional practice of putting ordinary safety valves on feed water heaters and similar apparatus. Due to its small discharge area, a safety valve has hardly any perceptible influence on the rise in back pressure if the exhaust to atmosphere be blocked while the engine is running at full load.

Types of Safety Exhaust Outlet Valves.

Safety exhaust outlet valves for exhaust steam service are commonly known under two different names :—back pressure valves, where the pressure of the steam is normally higher than that of the atmosphere ; and atmospheric relief valves, where the pressure underneath the valves is normally much less than atmosphere, as in condenser service, the valve being arranged to prevent a dangerous rise in pressure, should for instance the circulating water fail. Back pressure valves proper are usually fitted with means for adjusting the pressure at which they will discharge or "pop," while atmospheric relief valves are usually so arranged that a water seal can be maintained over the valve in order to prevent the infiltration of air between the valve and seat. Many valves, with slight modifications, can be, and are, used indifferently for either service.

The various types of valves on the [illegible] be brought under two general [illegible]ons, those having a single plain valve disk and those having balanced disks. Taking the simple disk as an example, let us study the requirements and mode of action. The back pressure valve is intended to limit the pressure within the exhaust steam system by opening, and allowing the escape of steam as soon as the pressure begins to rise above a predetermined amount. Where the volume of exhaust steam received by the system

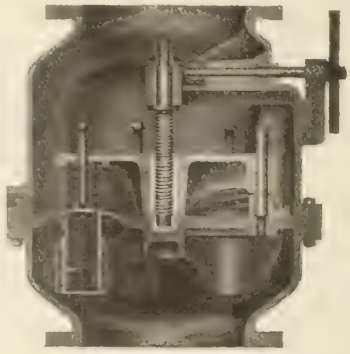


Fig. 2 — The Cochrane Multiport Safety Exhaust Outlet Valve.

is only a little greater than that consumed therein, it frequently happens that the valve must open and close at each pulsation of the engine :—twice per revolution in the case of a single cylinder engine. The disk may therefore be called upon to rise and fall from 100 to 300 times per minute. In many cases, the disk is held to its seat by weights, so that not only must the valve disk itself lift with this frequency, but the weight as well.

Lift of Back Pressure Valves.

The distance through which the valve disk must more during each oscillation is determined by the amount of exhaust steam to be discharged, since the maximum velocity at which the steam can escape is rigidly determined by the back pressure. If by opening to its widest extent, the valve is unable to discharge the amount of steam on hand, the pressure within the system will continue to rise until the velocity through the valve is sufficiently accelerated, or until some part gives way, or until the engine is stalled. A little elementary arithmetic will show that in order to present a free area of opening equal to the area of the circle formed by the valve seat, a valve disk will need to lift through a distance equal to the quarter of the seat diameter valve seat. Thus an 8 in. valve will need to lift 2 ins. ; a 16 in. valve 4 ins. : a 24 in. valve 6 ins. ; and so on.

As a matter of fact, back pressure valves, as actually constructed, rarely or never lift these amounts, and which may be explained as follows. Suppose the valve is set for 10 lb. back pressure, and has an area of 100 sq. ins., then it will be necessary to apply to the valves a load of 1,000 lbs., either by means of a weight, springs or otherwise. As soon as the pressure beneath the valve rises to 10 lbs. per sq. in., the valve will lift and the steam will begin to escape under the edge of the disk. This, however, will be accompanied by a reduction in pressure of the steam, since it is only by loss of pressure that the steam can gain velocity, so if we conceive a valve

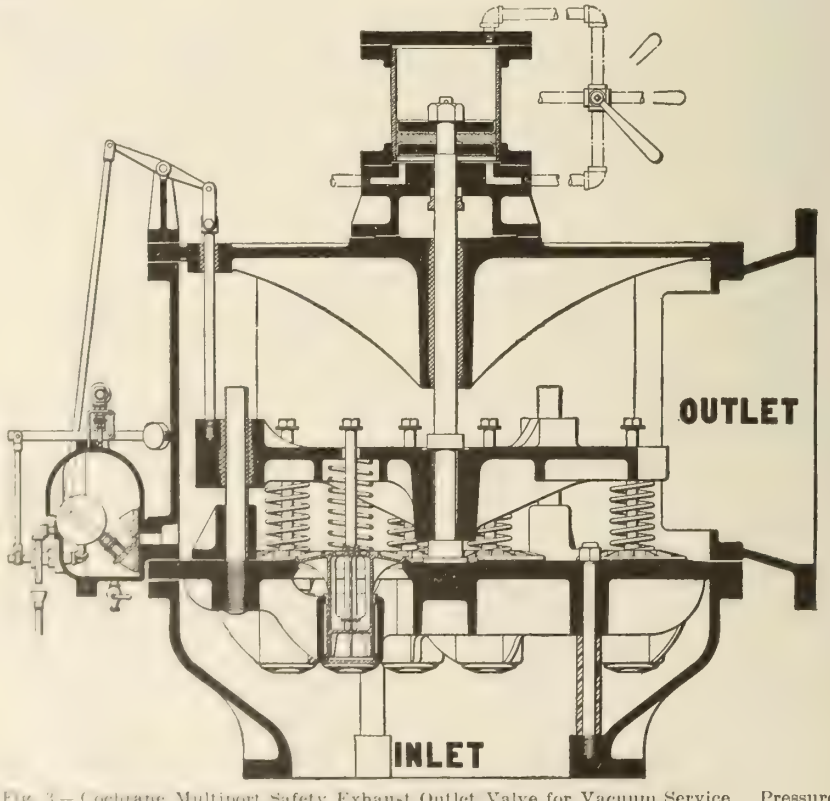


Fig. 3 — Cochrane Multiport Safety Exhaust Outlet Valve for Vacuum Service. Pressure Plate controlled from a distance by means of Hydraulic Pressure.

to be lifted sufficiently to permit of the escape of a jet of steam at the full velocity due to the pressure, and filling the entire circle of the valve disk, we must conceive that the static pressure of the steam beneath the valve is zero.

Under these circumstances, the question naturally arises as to what will support the 1,000 lbs. with which the valve is loaded. The only force available is the impulse of the jet of steam escaping from the valve. If this jet of steam were turned entirely through a right angle, without losses of any kind, it should be able to support a weight as great as the original load on the valve. As a matter of fact, however, the jet of steam is rarely turned through a complete right angle, and, moreover, the coefficient of discharge of the nozzle formed by the opening in the valve seat is much below unity, therefore, the valve at best opens only grudgingly, and does not discharge the full quantity of steam that it might be expected to, on the basis of its area of opening and the difference in pressure producing the velocity. The result is that all valves of the single disk type show a marked increase in back pressure, if the load rises near to the supposed capacity of the valve. Again, since the valve never rises to the theoretical limit of one quarter of its diameter, the area of discharge under it is determined by the length of the periphery, rather than by the area of the opening in the valve seat.

Hammering on Valve Seat.

The lift has an important bearing upon the operation of valves of this kind. The greater the diameter of the valve, the greater the distance through which it must lift to give an area of opening comparable to the opening in the valve seat. Again the greater the lift, the greater will be the velocity and the hammering action when the valve comes back upon the seat again. This must necessarily be the case, since the load, (the weight of the valve plus the weight or the force of the spring with which it is loaded) is determined by the area of the opening in the valve seat.

The more or less theoretical deductions already cited are aptly borne out by practical experience. For instance, in a recent issue of "Power," Mr. Chas. H. Smoot says:—"The steam valves which are called upon to pass various fluxes of steam encountered in steel-mill work are of great importance. The usual relief valves at present designed for service with condensing engines are wholly inadequate for this work. The passage of steam occurs with the violence of an explosion, and the valve must be capable of opening and closing its full travel many times in each minute, without pounding itself to pieces. Some of the valves required are over 36 inches diameter, with moving parts whose weights may reach as high as 1,000 lbs., and must oscillate up and down, with a travel of some 6 inches or more, 25 or 30 times a minute. The mechanical difficulties of construction are apparent. The force of the blow, with which such a valve would strike its seat, would be on a par with that of a steam hammer, if special provision were not made to absorb it.

The disastrous effects of the hammering on the valve seat will be apparent, especially where it is essential to maintain a nice fit for high vacuum with steam turbines. It is a common practice to start up engines or steam turbines non-condensing, and after the engine or turbine is properly warmed and drained and is operating satisfactorily. it is thrown over to the condenser. During the non-condensing period, the atmospheric relief valve is held open by a hand adjustment, leaving a clear passage for the steam. At the moment of throwing over, however, this adjustment is released, and the valve is temporarily allowed to hammer on its seat, while the main exhaust gate valve between the engine and the condenser is being opened. As soon as the vacuum reaches the relief valve, the latter will hold to its seat, and the operation is completed. The oscillations of the relief valve are more or less efficiently steadied by means of a dash pot, but even so, with the rubber composition face and brass disk usually employed, the rubber, being exposed to steam at 212 degs. F., and to oil, soon fails, and in all condensing plants the most common causes of low vacuum, therefore, are leaks through the relief valve.

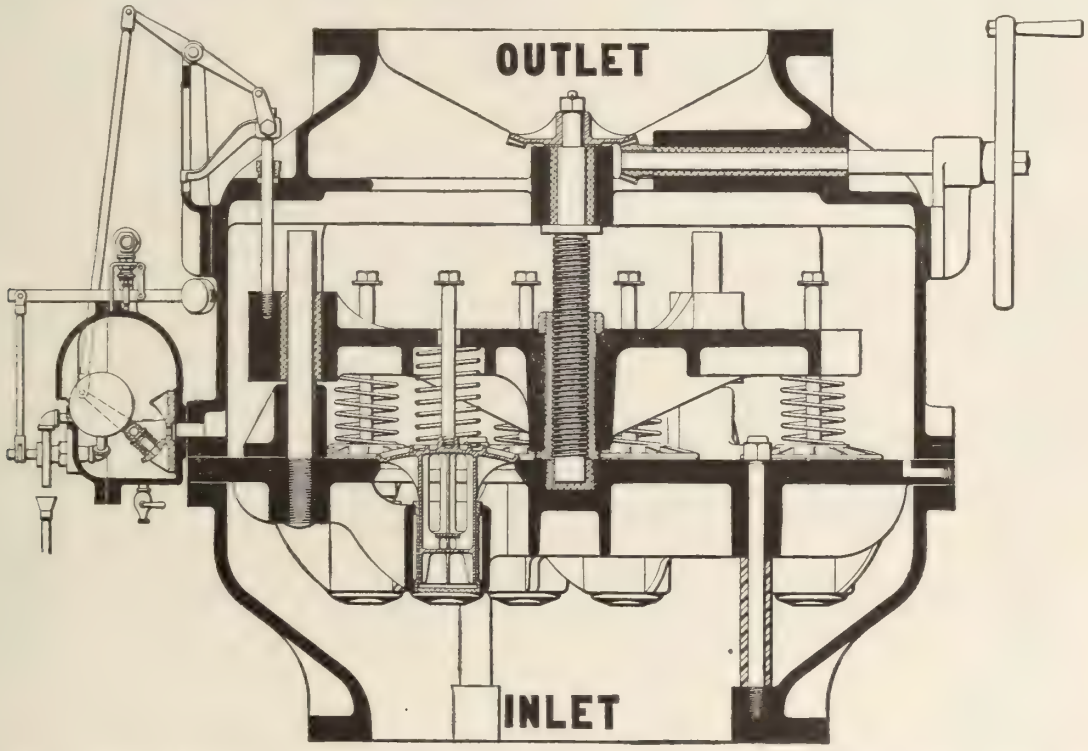


Fig. 4 — Cochrane Multiport Safety Exhaust Outlet Valve for Vacuum Service, showing trap-controlled Water Seal.

Large Single Disk Valves.

The large single-disk valve is very sluggish in action, due to the inertia of the heavy disk and connected weight. When the main gate valve to the condenser is opened, a drop in vacuum almost invariably occurs, owing to a certain volume of air being drawn into the condenser through the relief valve, before the disk of the latter can seat. With a jet condenser, this is extremely object-

ionable, particularly where the condenser must operate with a high injection lift, and in many cases, the throwing over is a difficult and hazardous procedure, since the drop in vacuum at the moment of opening the exhaust gate valve is often sufficient to cause the injection water to be lost. Considerable experience and judgment on the part of the operating engineer are required to adjust the atmospheric relief, the main exhaust gate valve and the injection valve, so that the throwing over may be accomplished with the minimum damage and without losing the injection water.

Balanced or Double-seated Disk Valves.

In order to diminish the diameter of the valve opening and, therefore, the lift, some valves are fitted with balanced or double-seated disks. This expedient is effective to a certain extent in accomplishing its purpose, as the mass to be accelerated and brought to rest with each stroke, and the distance of travel are both reduced. Other difficulties are, however, likely to arise. A double-seated valve that will be tight under all conditions of temperature and pressure is difficult and expensive, if not impossible to make, and since the only force tending to open the valve is the unbalanced steam pressure on the area which one disk possesses in excess of the other, there is a great probability of the valve sticking.

Multiple Disk Valves.

In the accompanying illustrations there is shown a type of valve in which the foregoing difficulties appear to have been well overcome. The valve may be described briefly as consisting of a valve deck upon which are placed a multitude of small valve disks, each individual unit having a spring to hold it closed, a water cushion or dash pot to arrest its motion and prevent damage to the disk and its seat, and a stem by means of which it may be lifted free of the seat when desired. The tension of the spring is determined by the position of a pressure plate, adjustable by means of a vertical screw, which may be turned one way or the other through bevel gears operating a horizontal shaft extending to the exterior of the valve casing. A hand wheel, chain wheel or gear wheel is fitted, as circumstances may dictate. The valve deck is placed between the flanges of the bottom and top [illegible] the latter having two or more [illegible] plates or doors for access to the former.

From the type of valve disks used, their large number, and the fact that [illegible] are made of bronze, as are also the [illegible] of the dashpot, it will be seen that the probability of sticking is largely reduced. Even should one disk be deranged, or for some reason refuse to leave its seat, the other disks will continue in operation. Therefore, the possibility of all disks of a valve becoming inoperative at one time is exceedingly remote.

Gain in Effective Discharge Area.

The gain in effective discharge area through the use of the small disks is considerable. As an example, let us take a 10 in. valve. With a single disk, the area of the valve would be 78.7 sq. ins., while the periphery or length of valve seat would be 31.4 ins. If the area of this valve were distributed among six small disks, each would have an area under the disk of 13.1 sq. ins., and a length of valve seat of 12.8 ins. Since there are six disks, the total length of valve seat would be 77 ins., or over twice as much as in the case of the single disk having the same area. As these individual disks are small and light, and are held to their seats by springs instead of weights, the total mass in motion when they close is comparatively small. They not only respond quicker, but strike their seat with much less force per lineal inch than does the large disk held down by a weight. The seating of the disks is retarded by cushions of water in the dash pots beneath. It is found that there is always water in these, due to the condensation of the steam, but where dash pots are inverted, as in some types of valves, they will contain only steam or air, which is not as effective in arresting the motion of the plunger as is water.

Spring Tension Adjustment.

An important advantage of this design of valve is found in the means for adjusting the tension of the springs. This may be done with great nicety by raising or lowering the pressure plate. At the same time, however, it is impossible for a certain pressure to be exceeded without substituting new springs, for when the pressure plate is down all the way, the springs are compressed to the maximum extent. The ease and convenience of adjustment is in marked contrast to the labor involved in shifting heavy weights on a lever. These often weigh two or three hundred pounds, and require the assistance of several men.

The illustrations show not only the ordinary back pressure valves, intended for exhaust steam heating, drying and similar service, but also valves for vacuum service. The latter differ chiefly in the use of lighter springs, and in provision made for water sealing. The water seal may be of the simple overflow type, the water entering through the valve connection at the left and overflowing at the right, or it may be of the trap controlled type, shown in Fig. 4 which is more economical of water, since, when the water reaches the required depth on the plate, further admission is cut off by the float in the float chamber. In order to prevent waste of water when the valves are raised for exhausting free to atmosphere, a system of levers is provided which closes a valve in the supply pipe. As seen in Fig. 4, an indicator is provided on the outside showing when the disks are fully raised or closed.

The three drawings, Fig. 1, illustrate the several positions of the pressure plate and valve disks with the valve set to the maximum back pressure, with the valve disks just touching the seat, as when only a few ounces of back pressure are required to force steam into heaters or other apparatus, and finally with the valves raised to the maximum height to allow free exhaust to atmosphere.

The improved type of valve herewith described and illustrated, is known as the Cochrane Multiport Safety Exhaust Outlet valve, and is manufactured by the Harrison Safety Boiler Works, Philadelphia, Pa., and handled throughout Canada by the Canada Foundry Company, Limited, Toronto, Ont., to whom we are indebted for the information and illustrations used in the preparation of this article. This company also controls patents fully protecting the several novel features involved.

HIGHEST SMOKESTACK IN MONTREAL.

Work has just been completed on what is claimed to be the biggest chimney in Montreal. This stack is part of the plant for heating the new station of the C.P.R. at Windsor street. It is 211 feet high, and stands on a foundation of concrete, sixteen feet square, and running down to solid rock. The lower ninety feet of the chimney is of concrete, and the upper 121 feet of brick. C.P.R. men are just a little bit proud of the heating system for the new station, the boilers for which will soon be in position. The system has been planned to give the maximum of efficiency with the minimum of labor. The arrangement for storing the coal will allow it to be fed into the furnaces without handling, and the ashes will be discharged directly into the cars for quick removal. The steam piping is carried to the station through a 300-foot concrete tunnel.

The Boston anti-smoke law, which was enacted last year, has not only eliminated to a large extent the smoke nuisance, but also has aroused among engineers a keen interest in the problem of combustion.

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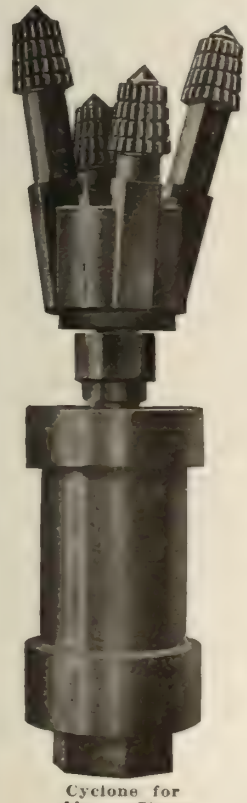

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The Foundation Company which has been at work since the month of July, 1910, enlarging the piers of the Canadian Pacific Railway bridge over the St. Lawrence river from Highlands to Caughnawaga, has completed that important undertaking, and the superstructure which is being put up by the Dominion Bridge Company, Montreal, will also be completed early in the coming year.

MAY USE OLD STYLE ENGINES.

There is said to be a strong possibility that the Pennsylvania will go back to the old style of passenger locomotive if experiments that are being made continue to give satisfactory results. For some time, the company has been compiling statistics relative to fuel consumption on passenger engines. It is stated that certain of these show a saving in the operation of particular trains, while others do better with heavier hauls. The new engines in use for several years have made good in the matter of speed, but as only some trains require that extra speed be made, the officials believe that those making more stops and operated on a slower schedule can get along very well with the old style engine.

ENGINEERS' CLUB, MONTREAL.

Mr. J. W. Fraser read a paper, illustrated by slides, at the Engineers' Club, Montreal, on the Southern Power Company's Transmission Lines, which operate in Northern Carolina. In tracing the early stages of electrical transmission, the lecturer mentioned that the Missouri River Power Plant was the first to operate commercially at 50,000 volts, and the Shawinigan transmission to Montreal was put into service a few months later. The Southern Power Company had been organized in 1905 for the purpose of developing certain water powers on the Catawba and Broad rivers. It had been built in sections, and in 1909 a 100,000 volt line of 250 miles was put in service. Since that time, a second circuit had been added and 140 additional miles of two-circuit 100,000 volt lines completed; a total of 1,380 miles of three-phase line. The greater part of the power was used by cotton mills. At the conclusion of the paper, which the chairman described as one of the most valuable contributions to the electrical section of the club, a discussion ensued, and thanks were expressed to the lecturer, who, it was pointed out, was an old McGill man.

Pig iron production in the United States shows a decided improvement. Steel works furnaces have made the greatest gains, and the merchant furnaces have turned the tide and now show a large daily gain.

The fireman's temper is one of the best indications of the quality of the coal and the condition of the fire.

An engineer with a chew of tobacco in his mouth and wearing a full-dress suit doesn't synchronize..

New York still leads in water power development, with 885,862 horse-power. California is second and Maine third.

TRADE NOTES.

The Robb Engineering Co. have recently sold return tubular boilers as follows: One 48 in. x 12 ft. to Albert Fraser, Clementsvale, N.S.; one 42 in. x 10 ft. to Frank L. Irving, Billtown, N.S.; and a 42 in. x 10 ft. heating boiler to Gorman, Clancey & Grindley, Edmonton, Alta.

The Goodyear Tire & Rubber Co., of Canada, Ltd., have just completed a very large addition to their factory at Bowmanville, Ont. It involved an expense of $170,000, which includes a new three storey building and additional machinery. This will greatly increase their capacity for the manufacture of Rubber Goods. The difficulty in the past year has been that their previous factory equipment was not sufficient to keep up with the orders which were received. Special machinery of the latest and most modern type for the manufacture of Mechanical Rubber Goods has been installed. The large Hose room is so constructed that there are no posts to obstruct the working of the overhead carriers. The labor question has been a serious one, especially due to the fact that there was no accommodation for help. It has been decided to build about sixty workmen's cottages; 26 of these being now under construction, and more will be added as soon as possible.

CATALOGUES.

Circular 1198, describing Alternating-Current Water-Wheel Generators has been issued by the **Westinghouse Electric and Manufacturing Co., of East Pittsburg, Pa.** The publication illustrates and describes the different types of generators, both vertical and horizontal, for water-wheel drive, manufactured by that company. It appears that the Westinghouse Company has several different types of rotor construction each of which is adapted for a certain rotor diameter and speed range. These types of construction are described in considerable detail. Other components of the water-wheel generators are given attention and many pictures of installations are shown. Numerous illustrations of water-wheel driven installations are shown.

Plastics, Ltd., Van Horne St., Toronto, have sent us a copy of their Catalogue E-F in which are listed their well-known Bakelite discs for globe valves and Bakelite pump valves. Bakelite is a new product that cannot be softened, fused or cracked by moisture, steam or chemicals and is meeting with much success.

Fyfe, Wilson & Co., Glasgow, Scotland, have sent us their Bulletin No. 112, which describes the Kelvin gasoline and kerosene-driven electricity generating sets. These have been designed for use in lighting farm and country houses, hotels, etc. In the Kelvin set, the engine is direct connected to the dynamo, the whole being mounted on one bed. The four-cycle or Otto principle has been adopted. The engine is fitted with the Bergins starting device, by means of which starting up without vigorous cranking is accomplished. Each generator set includes a storage battery of sufficient capacity to carry the lighting load under normal conditions for several days at a time—even during the darker season of the year. It is, therefore, only necessary to run the engine once or twice a week for a few hours. The various sets mounted on wooden trucks, with four small wheels, are readily portable by hand or horse haulage. The sizes vary from 3 to 16 kw.

Bulletin No. 48, "Resistance to Flow Through Locomotive Water Columns," by Arthur N. Talbot and Melvin L. Enger, records the results of tests of fourteen of the principal forms of locomotive water columns or cranes in use on the railways of the United States. Besides giving the loss of head at various rates of discharge, the tests provide data on the hydraulic characteristics of the valves. Water hammer, relief valves, friction losses through pipe lines, and methods to be used in the design of water service installations are also considered. The bulletin should be of interest to motive power and maintenance of way men. Copies of this bulletin may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

The Keuffel & Esser Co., New York, and Montreal, have mailed us their latest price list of flat wire tapes and band chains for the use of surveyors, contractors, etc.

"Tests of Nickel-Steel Riveted Joints," by Arthur N. Talbot and Herbert F. Moore has just been issued as Bulletin No. 49 of the Engineering Experiment Station of the University of Illinois.

The use of nickel-steel in the construction of bridges of great span is one of the interesting recent developments in the field of engineering. For many years it has been known that an alloy of nickel with steel possessed great strength and toughness, and hence nickel-steel has been extensively used as armor for battleships, and in other structures where the necessity for great strength was paramount.

To the casual observer, a steel bridge seems to be a rigid structure, but the engineer knows that microscopic movements of parts are constantly taking place as the bridge is exposed to wind, to heat and cold, or to the moving load of a passing train. There is no doubt that the use of nickel-steel would make possible the reduction of the weight of steel required to build a bridge, but the action of the riveted joints of the bridge, if nickel-steel were used, has not been known.

In considering designs for a new bridge over the St. Lawrence river, near Quebec, Canada, which is to replace the bridge that collapsed during the erection, the Board of Engineers of the Quebec Bridge, appointed by the Canadian Government, requested the Laboratory of Applied Mechanics of the University of Illinois to undertake a series of tests of nickel-steel riveted joints.

Bulletin No. 49 describes these tests, and also a series of tests on chrome-nickel-steel riveted joints made for the Pennsylvania Steel Company. It was found that the rivets of the nickel-steel riveted joints began to slip under loads just as low as did joints with ordinary steel rivets and plates, but that the nickel-steel joints carried higher loads before final tearing apart of the plates or shearing of the rivets. Tests were made in which the riveted joints were loaded in one direction, then in the other, and it was found that under such loading, the slip of rivets was much greater than under steady load.

Copies of Bulletin No. 49 may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

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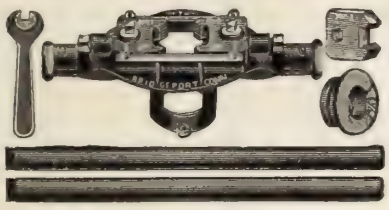

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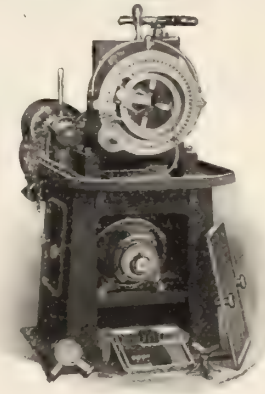

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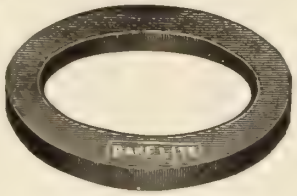

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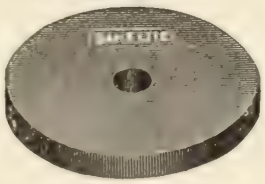

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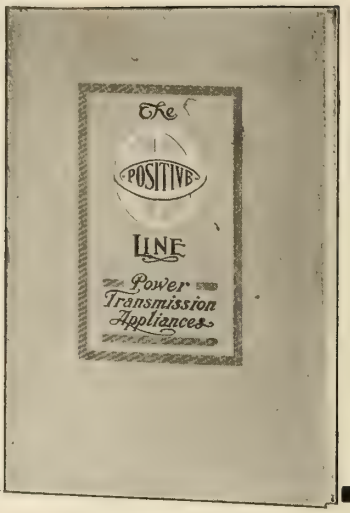

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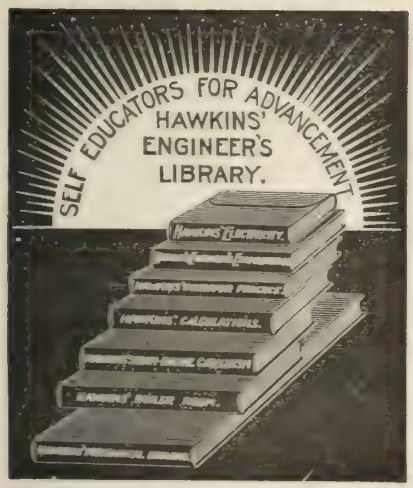

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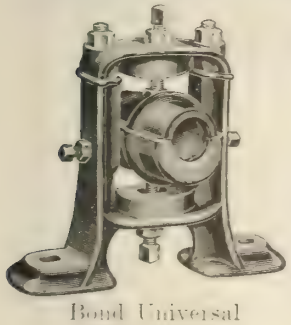

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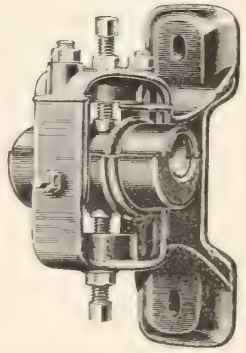

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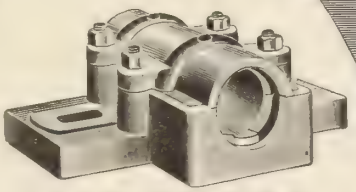

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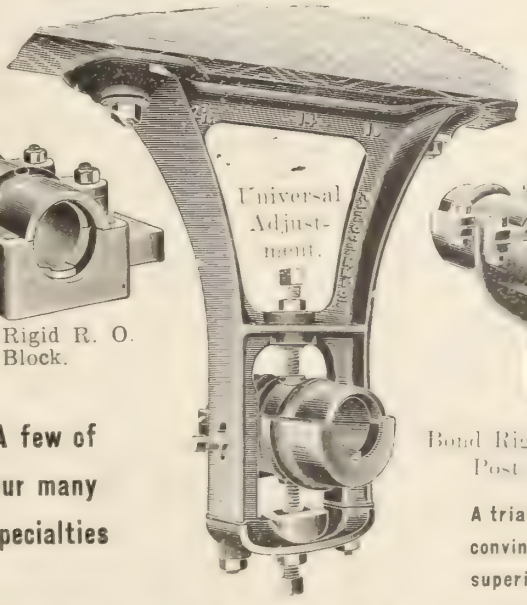

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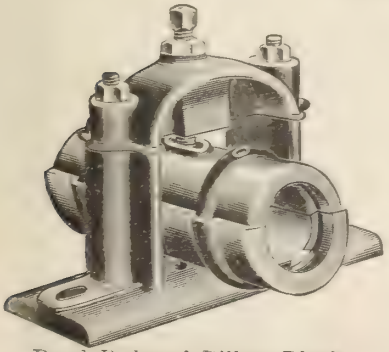

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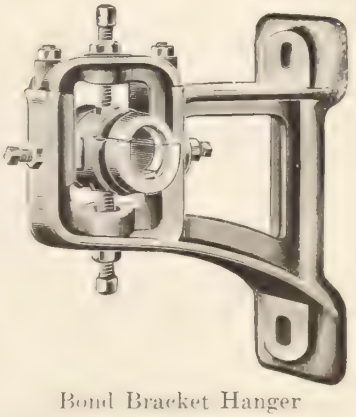

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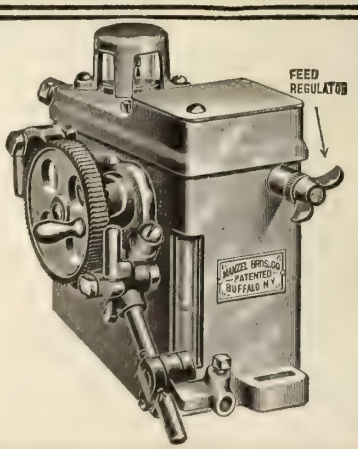

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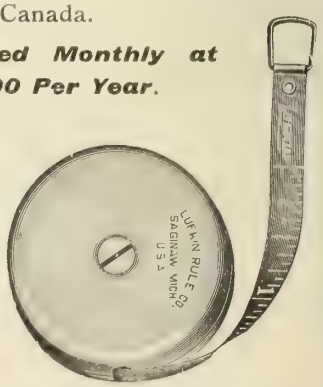

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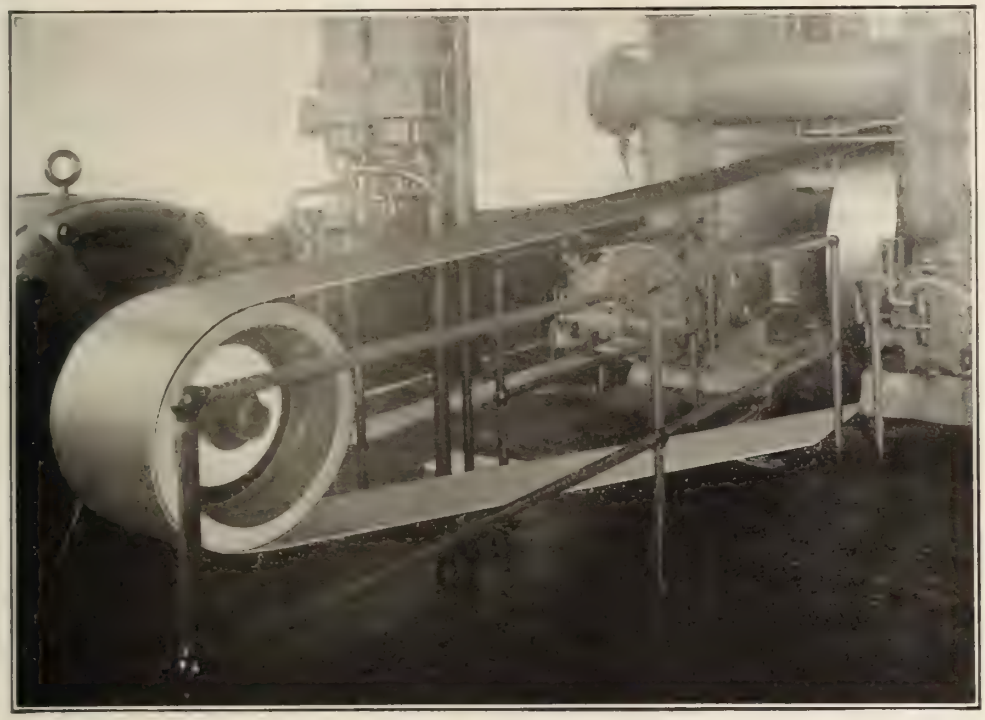

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Are you spending a good part of your Sundays at work in a Boiler?

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Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

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No new scale can form in any boiler in which "Eclipse" is correctly used.

Old scale is quickly removed by its action.

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In "Eclipse" Boiler Enamel we have a preparation which gives no heed to the class of water used, but in every case puts a filmy coating over the heating surfaces of the boiler, which makes it absolutely impossible for solid matter in any form to adhere to the iron. The scale-forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler in the form of a soft, soapy mud which will not burn or blister, and is most readily blown from the boiler.

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WRITE FOR LIST OF USERS, THEN WRITE THEM FOR FULL INFORMATION REGARDING THE EFFICIENCY AND RELIABILITY OF THIS SERVICEABLE BOILER ENAMEL.

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make **97** per cent. purification of water a practical possibility. The percentage of filtration is often higher.

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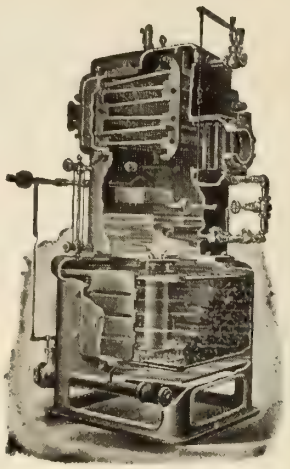

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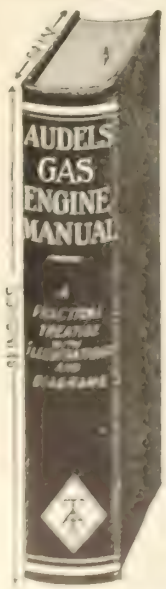

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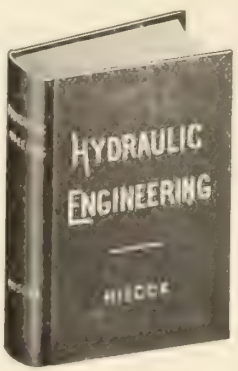

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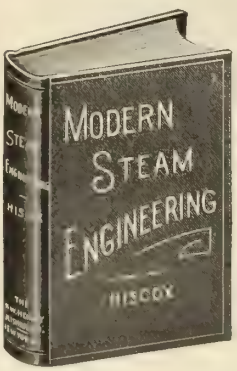

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By keeping the tubes free from scale it saves enough money in one year to pay for itself many times over.

We guarantee this compound to rid your boilers of all scale and prevent pitting, corrosion or other boiler troubles due to impure feed water.

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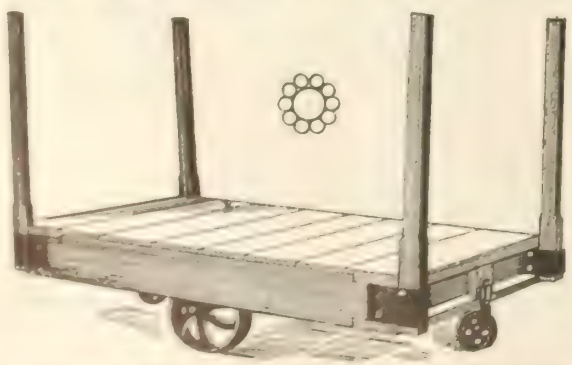

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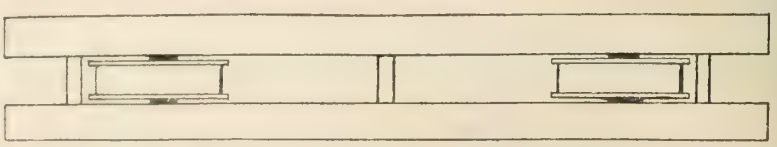

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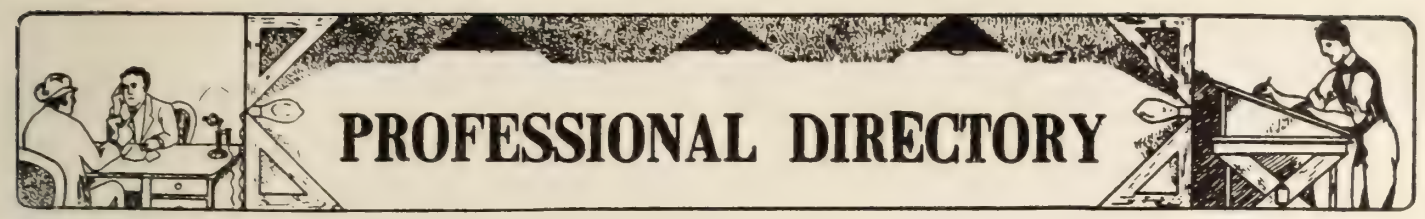

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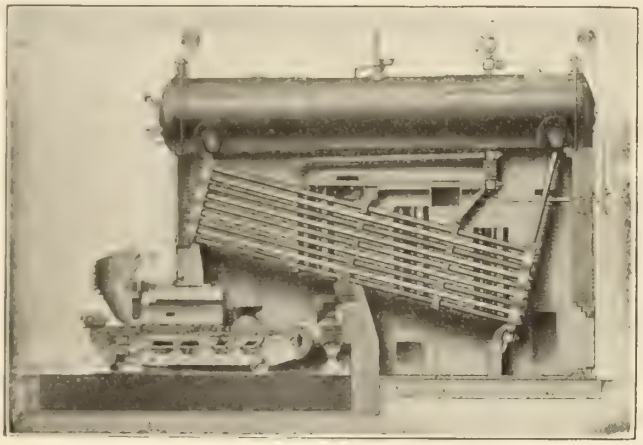

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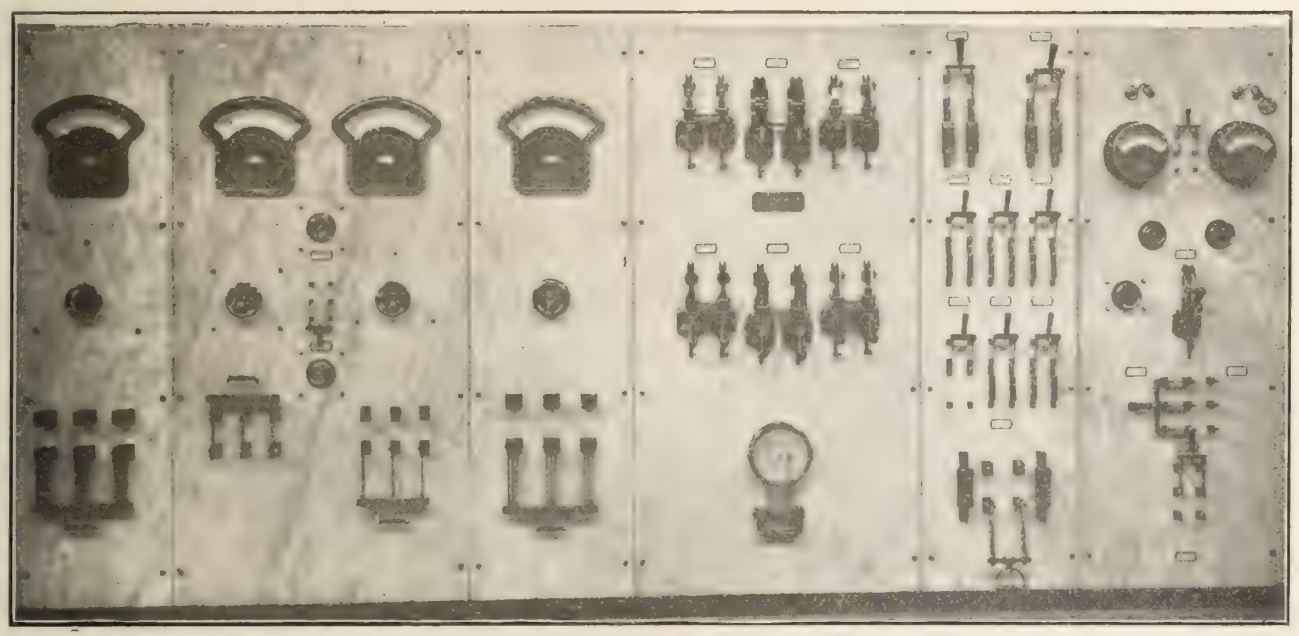

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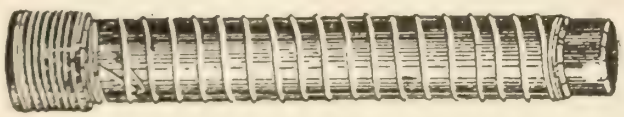

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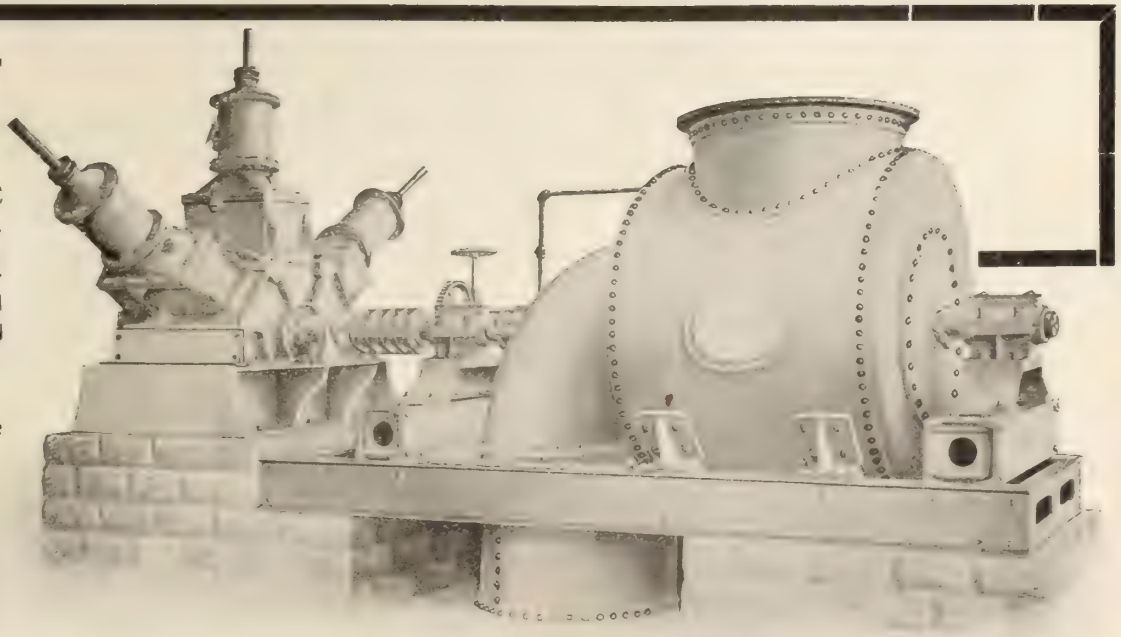

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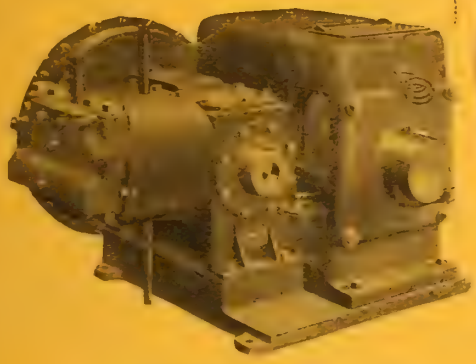
Westinghouse Air Compressors



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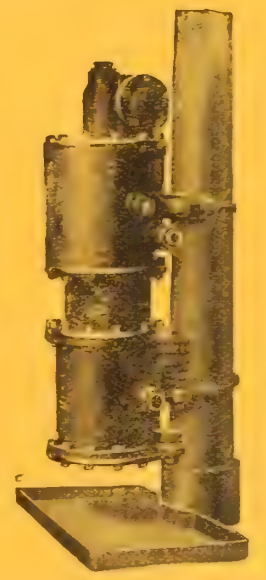

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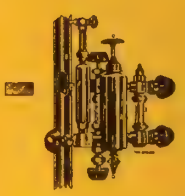
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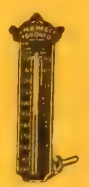
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VOLUME IV

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